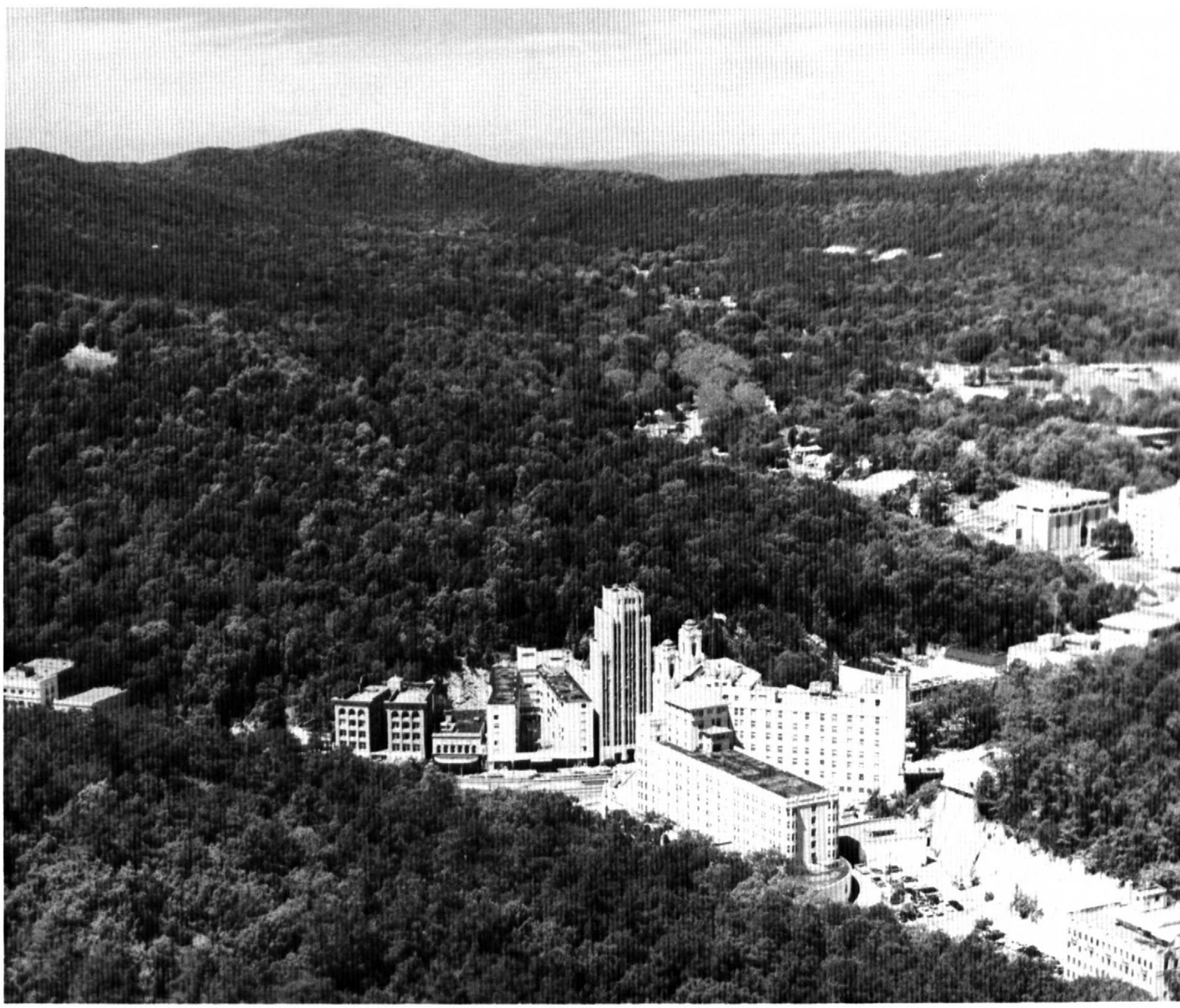
United States Department of Agriculture

Soil Conservation Service

In cooperation with United States Department of Agriculture Forest Service and the Arkansas Agricultural Experiment Station

Soil Survey of Garland County, Arkansas



How To Use This Soil Survey

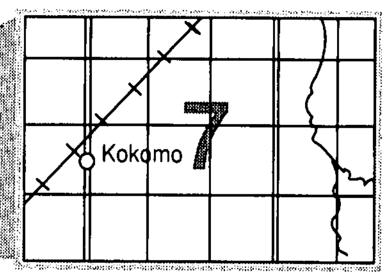
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

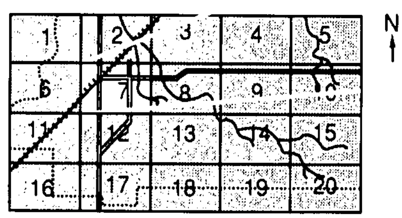
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.



MAP SHEET

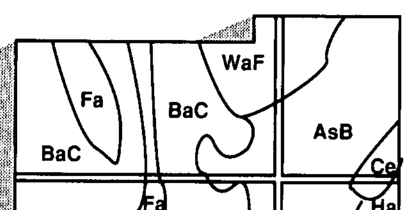
To find information about your area of interest, locate that area on the map on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



INDEX TO MAP SHEETS

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.

MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1985. Soil names and descriptions were approved in 1986. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This soil survey was made cooperatively by the Soil Conservation Service, the Forest Service, and the Arkansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Garland County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Downtown Hot Springs, Arkansas, surrounded by the Ouchita Mountains. Commercial wood production and urban development are the major uses of the soils in Garland County. Hot Springs is also a major tourist attraction.

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Soil Series

Issued December 1989

Index to Map Units

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Foreword

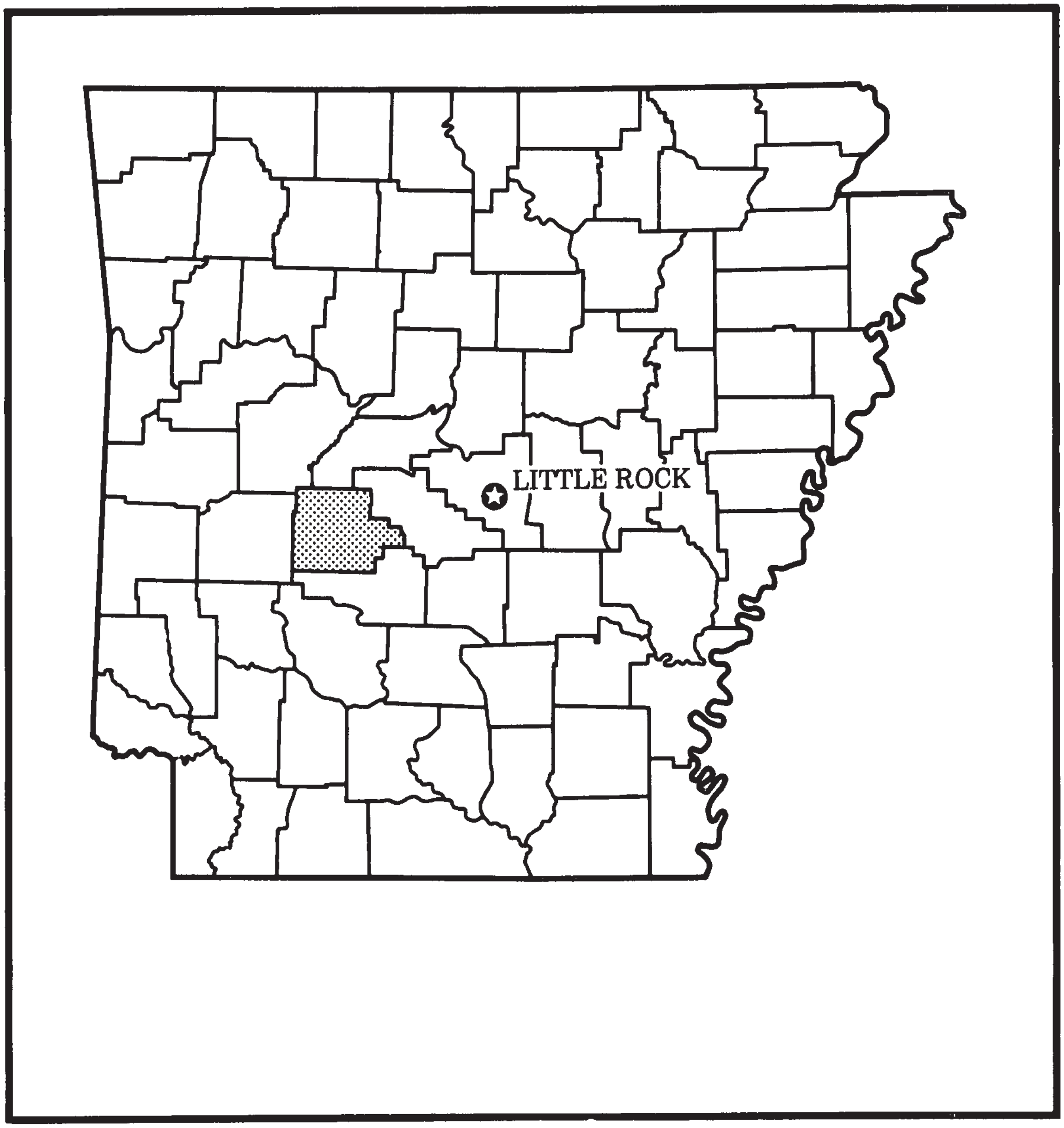
This soil survey contains information that can be used in land-planning programs in Garland County, Arkansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Albert E. Sullivan
State Conservationist
Soil Conservation Service



Location of Garland County in Arkansas.

Soil Survey of Garland County, Arkansas

By Glen D. Laurent, Johnny D. Chism, Ronald K. Rhodes, Curtis R. Wilson, and William R. Townsend, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
In cooperation with
United States Department of Agriculture, Forest Service and
Arkansas Agricultural Experiment Station

GARLAND COUNTY is in the west-central part of Arkansas. It extends about 26 miles from north to south and about 30 to 35 miles from east to west. Garland County has a total area of about 470,023 acres, or about 734 square miles, which includes about 49,601 acres of large bodies of water, mostly in Lake Ouachita, Lake Hamilton, and Lake Catherine. The total land area is about 420,422 acres. The county is bounded on the north by Yell, Perry, and Saline Counties; on the east by Saline and Hot Spring Counties; on the south by Hot Spring County; and on the west by Montgomery and Yell Counties.

In 1980, the population of Garland County was 70,531. Hot Springs is the county seat and has a population of 35,781.

Other important trading centers are Mountain Pine, Fountain Lake, and Jessieville.

The economy of Garland County is based mainly on commercial production of wood products and recreation and tourism. Farming and manufacturing are also important. Urban expansion is proceeding most rapidly in areas around Hot Springs, Lake Hamilton, and Lake Catherine.

General Nature of Garland County

This section provides general information about the history, farming, physiography and drainage, and climate of Garland County.

History

Garland County, located in west central Arkansas, was established April 5, 1873, from territory taken from Hot Spring, Montgomery, and Saline Counties. It was named for Augustus H. Garland, Governor and later U.S. Attorney General. Hot Springs was named as the county seat.

The springs around Hot Springs have attracted people for as long as 10,000 years. Stone artifacts found near the springs provide evidence that Indians used the water extensively. The area became a neutral ground where the different tribes came in peace to hunt, trade, and bathe. In 1541, the Spanish explorer Hernando DeSoto and his band of Conquistadors visited the hot springs and wintered on the banks of the neighboring Ouachita River. The French followed the Spanish into the area in the late 17th century.

The United States acquired the area when the Louisiana Territory was purchased from France in 1803. The next year, President Thomas Jefferson dispatched an expedition to explore the newly acquired springs. The report to the President was widely publicized and spawned interest in the "Hot Springs of the Washita."

In the years that followed, more and more people came to use the springs. The first bathhouse was built in 1830. In 1832, the Federal Government took the unprecedented step of setting aside four sections of land as a reservation to preserve the springs. In 1921, Congress designated the area as a national park. In 1907, parts of northern and western Garland County were proclaimed as Ouachita National Forest. In 1986, the forest covered 106,976 acres in the county.

Farming

Farming in Garland County began on soils that had good natural drainage. These soils were in high positions near the flood plain of the Ouachita River and its tributaries. Most areas of the better soils along the flood plain were cleared for farming, and the areas of steep, stony soils were left in woodland. Corn, oats, and wheat were grown for livestock feed, and vegetables were grown for family use as well as for sale in the expanding town of Hot Springs. Cotton was also grown as a cash crop. Most of the soils used by the early farmers were inundated when three lakes were built on the Ouachita River.

Most recently, farming has become more diversified and generally less intensive. In the southern part of the county, dairy herds, beef cattle, hogs, and poultry provide most of the farm income. A number of horse training farms are also located here.

In the northern part of the county, most of the land is used for timber production; only small areas along streams and upland flats are used for pasture and livestock production.

Physiography and Drainage

Garland County lies totally within the Ouachita Mountains physiographic area, which is characterized by tilted and folded, fractured layers of shale, sandstone, chert, and novaculite. The softer, less resistant shale, chert, and impure sandstone are more susceptible to erosion and form most of the basins, valley floors, and lower hills. The harder, more resistant novaculite and relatively pure layers of sandstone form the mountains, ridges, and peaks in the county.

Drainage in Garland County is generally toward the south and east. In the northwestern part of the county, the natural drainage system consists of many intermittent and perennial streams that drain into Lake Ouachita. Drainage in the northeastern part of the county is mainly by a series of natural drains that flow into the middle and south forks of the Saline River, which flows toward the east into Saline County. Drainage in the southwestern and central part of the county is mainly by a series of natural drains that flow into Mazarn Creek, Little Mazarn Creek, Glazypeau Creek, Bull Bayou, and Hallman's Creek, which empty into Lake Hamilton. Drainage in the southeastern part of the county is mainly by Gulpha Creek and Cooper Creek, which drain into Lake Catherine.

Domestic water sources are Lake Ouachita, Lake Hamilton, and wells and springs. Water for livestock is mainly from farm ponds, springs, and creeks.

Climate

Climatic data prepared by the National Climatic Data Center, Asheville, North Carolina.

Garland County is hot in summer, especially at low elevations, and moderately cool in winter, especially on mountains and high hills. Rainfall is fairly heavy and well distributed throughout the year. Snow falls nearly every winter, but snow cover lasts only a few days.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Hot Springs, Arkansas, for the period 1951 to 1981. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 44 degrees F., and the average daily minimum temperature is 33 degrees. The lowest temperature on record, which occurred at Hot Springs on January 10, 1962, is -1 degrees. In summer, the average temperature is 81 degrees, and the average daily maximum temperature is 92 degrees. The highest recorded temperature, which occurred at Hot Springs on August 30, 1954, is 111 degrees.

Growing degree days, shown in table 1, are equivalent to heat units. During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F.). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 30 inches, or 55 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 23 inches. The heaviest 1-day rainfall during the period of record was 8.35 inches at Hot Springs on July 16, 1963. Thunderstorms occur on about 56 days each year, and most occur in summer.

Average seasonal snowfall is 4 inches. The greatest snow depth at any one time during the period of record was 11 inches. On the average, 1 day had at least 1 inch of snow on the ground, but the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 55 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible sunshine is 70 percent in summer and 50 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 10 miles per hour, in spring.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material from which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, acidity, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are generally collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. In the detailed soil map units, these latter soils are called inclusions or included soils. In the general soil map units, they are called soils of minor extent.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed, and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soils on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or a building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their suitability for major land uses. Soil suitability ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used.

Each map unit is rated for *cultivated crops, pasture, woodland,* and *urban uses.* Cultivated crops are those grown extensively in the survey area. Pasture crops are those grown for livestock forage production. Woodland refers to areas of native or introduced trees. Urban uses include residential, commercial, and industrial developments.

1. Carnasaw-Pirum-Clebit

Deep, moderately deep, and shallow, gently sloping to very steep, well drained, stony, cobbly, and gravelly soils that formed in residuum of shale and sandstone

The soils of this map unit are on mountains and ridges mostly in the northern part of the county. The ridges and mountains generally are linear and irregular in shape. The tilt of the shale and sandstone beds is quite variable from ridge to ridge and it determines the position of the residual soils on the landscape. Carnasaw soils are deep and slowly permeable. These soils generally are on sides of mountains and ridges; in some places, they are on the crests. Pirum soils are moderately deep and moderately permeable. These soils generally are on sides and tops of mountains and ridges. Clebit soils are shallow and moderately rapidly permeable. These soils generally are on crests and upper side slopes of ridges and mountains. The soils of this map unit typically have stones, cobbles, and gravel on the surface, and boulders are on the surface in a few areas. The slopes range from 3 to 60 percent. The native vegetation is mostly pines and hardwoods.

This map unit makes up about 23 percent of the county. It is about 40 percent Carnasaw soils, 30 percent Pirum soils, 20 percent Clebit soils, and 10 percent soils of minor extent.

Typically, the Carnasaw soils have a surface layer of very dark grayish brown stony loam, cobbly loam, or gravelly loam. The subsurface layer is yellowish brown gravelly loam or stony loam. The upper part of the subsoil is strong brown silty clay loam, the middle part is red and yellowish red silty clay, and the lower part is strong brown channery silty clay. The substratum is soft, partly weathered shale tilted about 30 degrees from horizontal.

Typically, the Pirum soils have a surface layer of dark brown stony loam. The subsurface layer is light yellowish brown loam. The upper part of the subsoil is yellowish brown loam, and the lower part is strong brown clay loam. The substratum is fractured, hard sandstone bedrock that is tilted about 45 degrees from horizontal.

Typically, the Clebit soils have a surface layer of very dark grayish brown stony or bouldery loam. The subsoil is dark yellowish brown stony loam. The substratum is fractured, hard sandstone that is tilted about 45 degrees from horizontal.

The soils of minor extent in this map unit are Bismarck, Ceda, and Sherless soils and areas of rock outcrop. Bismarck soils are shallow, Ceda soils are deep, and Sherless soils are moderately deep.

In most areas, the soils of this map unit are used as woodland of mixed hardwoods and pines. Some areas of these soils have been clearcut and replanted to pine. Woodland productivity is moderately high for Carnasaw and Pirum soils and low for Clebit soils.

The soils of this map unit generally are not suited to cultivated crops and they are poorly suited or not suited to use as pasture. Stoniness and slope are the main limitations for agricultural uses and for most other uses.

Low strength, high shrink-swell potential, slope, surface stoniness, and depth to bedrock are moderate to severe limitations for most urban uses. These limitations require special design and planning for construction of dwellings, commercial buildings, roads and streets, and for installation of sanitary facilities.

2. Carnasaw-Bismarck

Deep and shallow, gently sloping to steep, well drained and somewhat excessively drained, gravelly and loamy soils that formed in residuum of shale

The soils of this map unit are throughout the county on shale hills and ridges that are on elevations lower than the adjacent sandstone and novaculite mountains. The resistance to weathering and the tilt of the shale beds determine the position of the soils on the landscape. The Carnasaw soils are deep, well drained, and slowly permeable. The Bismarck soils are shallow, somewhat excessively drained, and moderately permeable. The soils of this map unit are on sides and tops of hills and ridges. They typically have a gravelly surface layer. The slopes range from 3 to 40 percent. The natural vegetation is mostly pines, hardwoods, and cedar.

This map unit makes up about 27 percent of the county. It is about 40 percent Carnasaw soils, 35 percent Bismarck soils, and 25 percent soils of minor extent.

The Carnasaw soils have a surface layer of very dark grayish brown gravelly silt loam. The subsurface layer is yellowish brown gravelly silt loam. The upper part of the subsoil is strong brown silty clay loam, the middle part is red and yellowish red silty clay, and the lower part is strong brown channery silty clay. The substratum is partly weathered shale that is tilted about 30 degrees from horizontal.

The Bismarck soils have a surface layer of dark grayish brown gravelly silt loam. The subsurface layer is brown very channery silt loam. The subsoil is yellowish brown very channery silt loam. The substratum is red, brown, and gray, partly weathered, tilted shale.

The soils of minor extent in this map unit are Ceda, Mazarn, Pirum, and Sherless soils. The Ceda soils are deep and are on flood plains. The Mazarn soils are moderately deep and are on low terraces. The Pirum and Sherless soils are moderately deep and are in positions on the landscape similar to those of the Carnasaw and Bismarck soils.

Many areas of these soils have been clearcut and replanted to pine. Some areas that have less slope have been cleared and are used as pasture.

The native trees are mixed hardwood, pine, and cedar. Woodland productivity is moderately high for Carnasaw soils and low for Bismarck soils.

The soils of this map unit are poorly suited or not suited to cultivated crops, depending upon slope. These soils are moderately suited to poorly suited to pasture, depending upon slope.

Low strength, high shrink-swell potential, slope, and depth to bedrock are moderate to severe limitations for most urban uses. These limitations require special design and planning for construction of dwellings, commercial buildings, roads and streets, and for installation of sanitary facilities.

3. Yanush-Avant-Bigfork

Deep and moderately deep, gently sloping to very steep, well drained, very gravelly and stony soils that formed in residuum and colluvium of chert and novaculite

The soils of this map unit mostly are on novaculite mountains and chert hills. Smaller areas, however, are throughout the county. The novaculite mountains are linear and generally form a zig-zag pattern from east to west across the central part of the county. The chert hills generally are highly dissected and lie adjacent to the novaculite mountains. The novaculite beds are tilted, and the chert beds are folded and highly fractured. The soils of this map unit are deep and moderately deep and they are moderately permeable. The Yanush soils generally are on lower side slopes of the novaculite mountains and chert hills. The Avant soils generally are on upper side slopes and tops of the chert hills. The Bigfork soils generally are on upper side slopes and ridgetops of the novaculite mountains. The soils of this map unit are stony on the surface of the novaculite mountains and very gravelly on the surface of the chert hills. The slopes range from 3 to 60 percent. The native vegetation is mostly pines and hardwoods.

This map unit makes up about 19 percent of the county. It is about 30 percent Yanush soils, 22 percent Avant soils, 11 percent Bigfork soils, and 37 percent soils of minor extent.

Typically, the Yanush soils have a surface layer of dark grayish brown stony or very gravelly silt loam. The subsurface layer is brown stony or very gravelly silt loam. The subsoil is strong brown very gravelly to extremely gravelly silty clay loam.

Typically, the Avant soils have a surface layer of dark brown very gravelly silt loam. The subsurface layer is yellowish brown very gravelly silt loam. The subsoil is yellowish brown very gravelly silt loam in the upper part and strong brown very cobbly silty clay loam in the lower part. The substratum is highly fractured, tilted and folded chert bedrock.

Typically, the Bigfork soils have a surface layer of dark brown stony silt loam or stony loam. The subsurface layer is yellowish brown stony silt loam. The subsoil is yellowish red stony clay loam in the upper part and yellowish red very stony clay loam in the lower part. The substratum is hard, tilted, massive novaculite bedrock.

The soils of minor extent in this map unit are Bismarck, Ceda, and Carnasaw soils and areas of rock outcrop. Bismarck and Carnasaw soils are on hills and ridges at lower elevations. Bismarck soils are shallow, and Ceda and Carnasaw soils are deep. Ceda soils are on flood plains.

In most areas the soils of this map unit are used as woodland of mixed hardwoods and pines. Woodland productivity is moderately high for Yanush soils, moderate for Avant soils, and low for Bigfork soils. Stoniness, slope, and the depth to bedrock are the main limitations for agricultural uses and for most other uses.

The soils of this map unit generally are not suited to cultivated crops and they are poorly suited or not suited to pasture.

Slope, surface stoniness, and depth to bedrock are moderate to severe limitations for most urban uses. These limitations require special design and planning for construction of dwellings, commercial buildings, roads and streets, and for installation of sanitary facilities.

4. Bismarck-Sherless-Clebit

Shallow and moderately deep, gently sloping to steep, somewhat excessively drained and well drained, gravelly and very gravelly soils that formed in residuum of shale and sandstone

The soils of this map unit are on hills and ridges in the southern part of the county. The ridges and hills are linear and irregular in shape. The tilt of the shale and sandstone beds is quite variable from ridge to ridge and it determines the position of the residual soils on the landscape. Bismarck soils are shallow and gently sloping to steep. They are somewhat excessively drained and moderately permeable. The Sherless soils are moderately deep and gently sloping to steep. They are well drained and moderately permeable. The Clebit soils are shallow and gently sloping to steep. They are well drained and moderately permeable. The soils of this map unit are typically gravelly on the surface. The slopes range from 3 to 30 percent. The vegetation is mostly pasture grasses and in some areas, pines and hardwoods.

This map unit makes up about 24 percent of the county. It is about 30 percent Bismarck soils, 25 percent Sherless soils, and 10 percent Clebit soils, and 35 percent soils of minor extent.

The Bismarck soils have a surface layer of dark grayish brown gravelly silt loam. The subsurface layer is brown very channery silt loam. The subsoil is yellowish brown very channery silt loam. The substratum is red, brown, and gray, partly weathered, tilted shale.

The Sherless soils have a surface layer of dark brown gravelly fine sandy loam. The subsurface layer is light yellowish brown gravelly fine sandy loam. The subsoil is yellowish red clay loam. The substratum is red, brown, and gray, fractured, soft, weathered sandstone.

The Clebit soils have a surface layer of very dark grayish brown very gravelly loam. The subsoil is dark yellowish brown very gravelly loam. The substratum is fractured, hard sandstone.

The soils of minor extent in this map unit are Bonnerdale, Carnasaw, Ceda, Mazarn, and Pirum soils. Bonnerdale soils are deep and are on low terraces. Carnasaw soils are deep, and Pirum soils are moderately deep. These soils are in positions on the landscape similar to those of the soils in this map unit. Ceda soils are deep and are on flood plains. Mazarn soils are moderately deep and are on low terraces.

These soils are used mainly as pasture, although some areas are woodlands of pine and hardwood. Woodland productivity is moderately high for Sherless soils and low for Bismarck and Clebit soils. The slope and depth to bedrock are the main limitations of these soils for agricultural uses and for most other uses.

The soils of this map unit are poorly suited or not suited to cultivated crops. These soils are well suited to poorly suited to pasture.

Slope and depth to bedrock are moderate to severe limitations for most urban uses. These limitations require special design and planning for construction of dwellings, commercial buildings, roads and streets, and for installation of sanitary facilities.

5. Ceda-Spadra-Avilla

Deep, level to gently sloping, well drained, gravelly and loamy soils that formed in alluvial sediment

The soils of this map unit are on terraces and flood plains along Glazypeau Creek, Mazarn Creek, Little Mazarn Creek, North Fork Creek, the middle fork of the Saline River, and other small streams in the county. Ceda soils are level to nearly level. They are on flood plains and are frequently flooded. Spadra soils are level to nearly level. They are on terraces and are occasionally flooded. Avilla soils are nearly level to gently sloping. They are on stream terraces at elevations where flooding typically does not occur. Ceda soils are rapidly permeable, and Spadra and Avilla soils are moderately permeable. The soils of this map unit have a loamy and gravelly surface layer. The slopes range from 0 to 8 percent.

This map unit makes up about 7 percent of the county. It is about 50 percent Ceda soils, 20 percent Spadra soils, 15 percent Avilla soils, and 15 percent soils of minor extent.

The Ceda soils have a surface layer of dark brown gravelly loam. The underlying material is yellowish brown very gravelly loam.

The Spadra soils have a surface layer of dark brown loam. The subsoil is yellowish red clay loam in the upper part and strong brown clay loam and loam in the lower part. The substratum is strong brown loam.

The Avilla soils have a surface layer of dark yellowish brown silt loam. The subsurface layer is yellowish brown silt loam. The subsoil is yellowish red clay loam in the upper part, red clay loam in the middle part, and red gravelly and very gravelly clay loam in the lower part.

The soils of minor extent in this map unit are Bonnerdale, Mazarn, and Leadvale soils. Bonnerdale soils are deep and are on low terraces. Mazarn soils are moderately deep and are on low terraces. Leadvale soils are deep and are on terraces.

These soils are used mainly as native or improved pasture. Woodland productivity is moderately high for the soils of this map unit. Flooding and slope restrict the use of these soils for agricultural uses and for most other uses.

Spadra soils are well suited to cultivated crops, although occasional flooding is a moderate hazard. Avilla soils are well suited to moderately suited to cultivated crops, depending upon slope. Ceda soils are not suited to cultivated crops because of droughtiness and frequent flooding. Spadra and Avilla soils are well suited to use as pasture, and Ceda soils are poorly suited.

Spadra and Ceda soils are limited for most urban uses because of flooding. Major flood control systems are needed to overcome this hazard. Avilla soils are well suited to most urban uses.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Carnasaw gravelly silt loam, 3 to 8 percent slopes, is one of several phases in the Carnasaw series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Bismarck-Carnasaw complex, 20 to 40 percent slopes is an example.

A *soil association* is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in a mapped area are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

1—Avant very gravelly silt loam, 3 to 15 percent slopes. This soil is moderately deep, gently sloping to moderately steep, and well drained. It is on tops of chert hills. The areas of this soil range from about 10 to 100 acres or more. Slopes generally are convex.

The typical sequence, depth, and composition of the layers of this Avant soil are as follows:

Surface layer:
0 to 3 inches; dark brown very gravelly silt loam

Subsurface layer:
3 to 7 inches; yellowish brown very gravelly silt loam

Subsoil:
7 to 17 inches; yellowish brown very gravelly silt loam
17 to 36 inches; strong brown very cobbly silty clay loam

Substratum:
36 to 42 inches; highly fractured, tilted and folded, chert bedrock with thin strata of mottled, stratified clay, clay loam, and very fine sandy loam

Important properties of this Avant soil:

Permeability: moderate

Available water capacity: low

Soil reaction: medium acid to very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches, (rippable)

Included with this soil in mapping are a few small areas of Bigfork, Carnasaw, and Yanush soils. Also included are a few areas of soils that have a very cobbly silt loam surface layer.

This Avant soil is mainly used as woodland.

This soil is poorly suited to use as pasture and is not suited to cultivated crops. The hazard of erosion is very severe if the surface cover is removed. The high content of chert gravel fragments on the surface makes seedbed preparation difficult. The high content of coarse fragments in the subsurface layer and subsoil lowers the available water capacity, which causes the soil to be droughty.

The potential of Avant soil for commercial production of wood products is moderate. Loblolly pine, shortleaf pine, southern red oak, and white oak are suitable trees. With proper management, this soil has the capability of producing 80 to 92 cubic feet per acre per year of shortleaf pine. The high content of chert gravel in the surface layer and subsoil lowers the available water capacity, which causes moderate seedling mortality. The high content of chert fragments on the surface also causes moderate limitations to the use of equipment.

This soil is poorly suited to most urban uses. Depth to bedrock is a severe limitation to the use of this soil for septic tank absorption fields. A specially designed system may be required. Steepness of slope is a moderate limitation for dwellings and local roads and streets, and a severe limitation for small commercial buildings. Designing the structure to conform to the natural slope or shaping and leveling the site can overcome or minimize the slope limitation. Large stones are moderate limitations to the use of this soil as sites for dwellings, commercial buildings, and local roads and streets.

This Avant soil is in capability subclass VIs and in woodland suitability group 6F8.

2—Avilla silt loam, 1 to 3 percent slopes. This soil is deep, nearly level, and well drained. It is on stream terraces. The areas of this soil range from about 20 to 150 acres.

The typical sequence, depth, and composition of the layers of this Avilla soil are as follows:

Surface layer:
0 to 3 inches; dark yellowish brown silt loam

Subsurface layer:
3 to 10 inches; yellowish brown silt loam

Subsoil:
10 to 29 inches; yellowish red clay loam
29 to 42 inches; red clay loam
42 to 52 inches; red gravelly clay loam
52 to 72 inches; red very gravelly clay loam

Important properties of this Avilla soil:

Permeability: moderate

Available water capacity: moderate to high

Soil reaction: strongly acid or very strongly acid throughout except where lime has been added

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: more than 6 feet

Included with this soil in mapping are small areas of Leadvale soils that are in positions on the landscape similar to those of Avilla soil. Also included are small areas of soils that have slopes of more than 3 percent and areas of soils that are less than 60 inches to bedrock.

This Avilla soil is mainly used as pasture.

This soil is well suited to use as pasture (fig. 1). Bermudagrass, bahiagrass, tall fescue, white clover, sericea lespedeza, and annual lespedeza are adapted pasture plants. Appropriate management practices include proper stocking, controlled grazing, maintaining the fertility level, and controlling brush and weeds.

This soil is well suited to cultivated crops. Soybeans, wheat, and grain sorghum are adapted crops. The hazard of erosion is moderate. Conservation tillage, contour farming, and cover crops reduce runoff and help to control erosion.

The potential of Avilla soil for commercial production of wood products is moderately high. With proper management, this soil has the capability of producing about 95 to 105 cubic feet per acre per year of shortleaf pine. Loblolly pine, shortleaf pine, and black walnut are suitable trees. This soil has no significant limitations for woodland management.

This soil is well suited to moderately suited to most urban uses. Moderate permeability is a moderate limitation for septic tank absorption fields; however, enlarging the absorption field can help to minimize this limitation. This soil has no significant limitations for dwellings, small commercial buildings, and local roads and streets.

Figure 1.—Avilla silt loam, 1 to 3 percent slopes, is a deep, well drained soil that is well suited to use as pasture, which is the main use. The forest in the background is on Bismarck and Carnasaw soils.

This Avilla soil is in capability subclass IIe and in woodland suitability group 7A7.

3—Avilla silt loam, 3 to 8 percent slopes. This soil is deep, gently sloping, and well drained. It is on stream terraces. The areas of this soil range from about 20 to 200 acres.

The typical sequence, depth, and composition of the layers of this Avilla soil are as follows:

Surface layer:
0 to 3 inches; dark yellowish brown silt loam

Subsurface layer:
3 to 10 inches; yellowish brown silt loam

Subsoil:
10 to 29 inches; yellowish red clay loam
29 to 42 inches; red clay loam

42 to 52 inches; red gravelly clay loam
52 to 72 inches; red very gravelly clay loam

Important properties of this Avilla soil:

Permeability: moderate

Available water capacity: moderate to high

Soil reaction: strongly acid or very strongly acid throughout except where lime has been added

Surface runoff: medium to rapid

High water table: none within a depth of 6 feet

Depth to bedrock: more than 6 feet

Included with this soil in mapping are small areas of Leadvale soils that are in positions on the landscape similar to those of Avilla soil. Also included are small areas of soils that are less than 60 inches to bedrock.

This Avilla soil is mainly used as pasture.

This soil is well suited to use as pasture. Bermudagrass, bahiagrass, tall fescue, white clover, sericea lespedeza, and annual lespedeza are adapted pasture plants. Appropriate management practices include proper stocking, controlled grazing, maintaining the fertility level, and controlling brush and weeds.

This soil is moderately suited to cultivated crops. The hazard of erosion is severe. Soybeans, wheat, and grain sorghum are adapted crops. Conservation tillage, contour farming, and cover crops reduce runoff and help to control erosion. The need for erosion control measures intensifies as slope length and gradient increase.

The potential of Avilla soil for commercial production of wood products is moderately high. With proper management, this soil has the capability of producing about 95 to 105 cubic feet per acre per year of shortleaf pine. Loblolly pine, shortleaf pine, and black walnut are suitable trees. This soil has no significant limitations for woodland management.

This soil is well suited to moderately suited to most urban uses. Moderate permeability is a moderate limitation for septic tank absorption fields; however, enlarging the absorption field can minimize this limitation. This soil has no significant limitations for dwellings and local roads and streets. Steepness of slope is a moderate limitation for small commercial buildings. Designing the structure to conform to the natural slope or shaping and leveling the site can help minimize the slope limitation.

This Avilla soil is in capability subclass IIIe and in woodland suitability group 7A7.

4—Bigfork-Rock outcrop complex, 3 to 15 percent slopes. This complex consists of Rock outcrop and a soil that is moderately deep, gently sloping to moderately steep, and well drained. This soil and Rock outcrop are on tops of mountains. Stones, cobbles, gravel, and a few boulders are on the surface. Stones and boulders are the most limiting features. This soil and Rock outcrop were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 15 to 200 acres or more.

This complex is made up of about 50 percent Bigfork soil, 20 percent Rock outcrop, and 30 percent other soils.

Typically, the Bigfork soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Bigfork soil are as follows:

Surface layer:
0 to 4 inches; dark brown stony loam

Subsurface layer:
4 to 9 inches; yellowish brown stony loam

Subsoil:
9 to 19 inches; yellowish red stony clay loam
19 to 31 inches; yellowish red very stony clay loam

Substratum:
31 to 35 inches; hard, tilted, massive, novaculite bedrock

Important properties of Bigfork soil:

Permeability: moderate

Available water capacity: low

Soil reaction: medium acid or strongly acid in the surface layer and subsurface layer and medium acid to very strongly acid in the subsoil

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (hard)

Included in mapping are areas of Avant soils and small areas of soils similar to the Bigfork soil except they are less than 20 inches to bedrock. Also included are a few areas of soils that have boulders on the surface.

The Bigfork soil is mostly used as woodland.

The Bigfork soil is severely limited to use as pasture. Surface stones limit the use of farm equipment for pasture management. An understory of native grasses is in some uncleared areas. Proper stocking, timely deferment of grazing, fire prevention, and brush control help keep the native grass pasture and soil in good condition and prevent erosion.

This Bigfork soil is not suited to cultivated crops because of the rapid surface runoff, very severe hazard of erosion, surface stones, and rock outcrop.

The potential of Bigfork soil for commercial production of wood products is low. With proper management, this soil has the capability of producing about 50 to 65 cubic feet per acre per year of shortleaf pine. Shortleaf pine, loblolly pine, southern red oak, and post oak are suitable trees. Use of equipment is restricted because of surface stones. Seedling mortality, caused by the low available water capacity, is moderate.

The Bigfork soil is poorly suited to most urban uses. Depth to bedrock and large stones are severe limitations for septic tank absorption fields and moderate limitations for dwellings and local roads and streets. A specially designed system can be required for waste disposal, depending upon depth to bedrock. Building above bedrock and landscaping with additional fill help to avoid the depth to bedrock limitation. Steepness of slope is a moderate limitation for dwellings and local roads and streets and a severe limitation for small commercial buildings. Designing structures to conform to the natural slope or shaping and leveling the site can overcome or minimize this limitation.

Bigfork soil is in capability subclass VIs. Rock outcrop is in capability subclass VIIIs. Bigfork soil is in woodland suitability group 4X8. Rock outcrop is not assigned to a woodland suitability group.

5—Bigfork-Rock outcrop complex, 35 to 60 percent slopes. This complex consists of Rock outcrop and a soil that is moderately deep, very steep, and well drained. This soil and Rock outcrop are on sides of mountains. Stones, cobbles, gravel, and a few boulders are on the surface. Stones and boulders are the most limiting features. This soil and Rock outcrop were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 500 acres or more.

This complex is made up of about 50 percent Bigfork soil, 20 percent Rock outcrop, and 30 percent other soils.

Typically, the Bigfork soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Bigfork soil are as follows:

Surface layer:
0 to 4 inches; dark brown stony loam

Subsurface layer:
4 to 9 inches; yellowish brown stony loam

Subsoil:
9 to 19 inches; yellowish red stony clay loam
19 to 31 inches; yellowish red very stony clay loam

Substratum:
31 to 35 inches; hard, tilted, massive, novaculite bedrock

Important properties of Bigfork soil:

Permeability: moderate

Available water capacity: low

Soil reaction: medium acid to strongly acid in the surface layer and subsurface layer and medium acid to very strongly acid in the subsoil

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (hard)

Included in mapping are areas of Avant and Yanush soils and small areas of soils similar to Bigfork soil except they are less than 20 inches to bedrock. Also included are a few areas of soils that have boulders on the surface and a few areas of soils that have slopes of less than 35 percent.

The Bigfork soil is mostly used as woodland.

The Bigfork soil is not suited to use as pasture or to cultivated crops. The use of farm equipment is restricted because of very steep slopes, very rapid surface runoff, a very severe hazard of erosion, surface stones, and rock outcrop.

The potential of Bigfork soil for commercial production of wood products is low. Shortleaf pine, loblolly pine, southern red oak, and post oak are suitable trees. With proper management, this soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine. Use of equipment is limited because of very steep slopes and stones on the surface. Seedling mortality, caused by the low available water capacity, is moderate. The hazard of erosion is a concern in management.

The Bigfork soil is severely limited for most urban uses. Depth to bedrock and large stones are severe limitations for septic tank absorption fields. Steepness of slope is a severe limitation for septic tank absorption fields, dwellings, small commercial buildings, and local roads and streets. This limitation is difficult to overcome and requires special designs for construction and for installation of sanitary facilities.

The Bigfork soil is in capability subclass VIIs. Rock outcrop is in capability subclass VIIIs. Bigfork soil is in woodland suitability group 4R9. Rock outcrop is not assigned to a woodland suitability group.

6—Bigfork-Yanush-Carnasaw complex, 20 to 40 percent slopes. This complex consists of soils that are steep and well drained. Bigfork soil is moderately deep, and Yanush and Carnasaw soils are deep. These soils are on sides of mountains. Stones, cobbles, and gravel commonly are on the surface. Stones are the most limiting feature. These soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 500 acres or more.

The complex is made up of about 40 percent Bigfork soil, 30 percent Yanush soil, 15 percent Carnasaw soil, and 15 percent other soils.

Typically, the Bigfork soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Bigfork soil are as follows:

Surface layer:
0 to 4 inches; dark brown stony silt loam

Subsurface layer:
4 to 9 inches; yellowish brown stony silt loam

Subsoil:
9 to 19 inches; yellowish red stony clay loam
19 to 31 inches; yellowish red very stony clay loam

Substratum:
31 to 35 inches; tilted, hard, massive, novaculite bedrock

Important properties of Bigfork soil:

Permeability: moderate

Available water capacity: low

Soil reaction: medium acid to very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (hard)

Typically, the Yanush soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Yanush soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown stony silt loam

Subsurface layer:
3 to 5 inches; brown stony silt loam

Subsoil:
5 to 44 inches; strong brown very gravelly silty clay loam
44 to 72 inches; strong brown extremely gravelly silty clay loam

Important properties of Yanush soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: medium acid to very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: more than 60 inches

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of this Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown stony loam

Subsurface layer:
2 to 5 inches; yellowish brown stony loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 32 inches; red and yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; soft, partly weathered shale, tilted about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Included in mapping are small areas of Avant soils and some areas of soils similar to Bigfork soil except they are more shallow to bedrock. Also included are some small areas of rock outcrop and small areas where boulders are on the surface.

In most areas, the soils in this complex are used as woodland. In a few areas, they are used for native pasture and urban development.

These soils are severely limited for use as pasture and are not suited to cultivated crops. Where pasture is established, however, plants include tall fescue and native grasses. In some areas, these soils can be used as native grass pasture if brush can be controlled. Controlled grazing and fire protection are needed to maintain soil cover and to prevent excessive erosion. Steepness of slope and surface stones severely restrict the use of farm equipment. The hazard of erosion is very severe.

The potential of Bigfork soil for commercial production of wood products is low, and the potential of Carnasaw and Yanush soils is moderately high. Shortleaf pine, loblolly pine, and southern red oak are suitable trees. With proper management, Bigfork soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine, Yanush soil has the capability of producing 95 to 105 cubic feet, and Carnasaw soil has the capability of producing 108 to 120 cubic feet. The soils in this complex have moderate limitations for equipment use because of steep slopes and surface stones that can restrict the use of rubber-tired skidders. The hazard of erosion is also a concern because of steep slopes. The high content of chert gravel in the surface layer and subsoil of Bigfork and Yanush soils lowers the available water capacity, which causes moderate seeding mortality.

The soils in this complex are poorly suited to most urban uses. Steepness of slope is a severe limitation to the use of these soils as sites for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. Designing structures to conform to natural slopes and shaping or leveling the site can offset the effects of steep slopes. In addition, Bigfork soil has a severe limitation for septic tank absorption fields because of depth to bedrock. Carnasaw soil has a severe limitation for septic tank absorption fields because of slow permeability; a severe limitation for dwellings, small commercial buildings, and local roads and streets because of the high shrink-swell potential; and an additional severe limitation for local roads and streets because of low strength. Depth to bedrock and slow permeability restrictions are difficult to overcome and require a specially designed system for septic tank absorption fields. Providing extra reinforcement, widening footings, and backfilling with sand minimize the effects of shrinking and swelling. Where soils have low strength, excavating and backfilling with a suitable subbase material can help prevent damage to roads and streets.

The soils in this complex are in capability subclass VIIs. Bigfork soil is in woodland suitability group 4R8, Yanush soil is in woodland suitability group 7R8, and Carnasaw soil is in woodland suitability group 8R8.

7—Bigfork-Yanush-Carnasaw complex, 40 to 60 percent slopes. This complex consists of soils that are very steep and well drained. Bigfork soil is moderately deep, and Yanush and Carnasaw soils are deep. These soils are on sides of mountains. Stones, cobbles, and gravel commonly are on the surface. Stones are the most limiting feature. These soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 500 acres or more.

This complex is made up of about 40 percent Bigfork soil, 30 percent Yanush soil, 15 percent Carnasaw soil, and 15 percent other soils.

Typically, the Bigfork soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Bigfork soil are as follows:

Surface layer:
0 to 4 inches; dark brown stony silt loam

Subsurface layer:
4 to 9 inches; yellowish brown stony silt loam

Subsoil:
9 to 19 inches; yellowish red stony clay loam
19 to 31 inches; yellowish red very stony clay loam

Substratum:
31 to 35 inches; tilted, hard, massive, novaculite bedrock

Important properties of the Bigfork soil:

Permeability: moderate

Available water capacity: low

Soil reaction: medium acid to very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (hard)

Typically, the Yanush soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Yanush soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown stony silt loam

Subsurface layer:
3 to 5 inches; brown stony silt loam

Subsoil:
5 to 44 inches; strong brown very gravelly silty clay loam
44 to 72 inches; strong brown extremely gravelly silty clay loam

Important properties of the Yanush soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: medium acid to very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: more than 60 inches

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown stony loam

Subsurface layer:
2 to 5 inches; yellowish brown stony loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 26 inches; red and yellowish red silty clay
26 to 32 inches; yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; soft, partly weathered shale, tilted about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: medium acid to very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Included in mapping are small areas of Avant soils and some areas of soils similar to Bigfork soil except they are more shallow to bedrock. Also included are some small areas of rock outcrop and small areas where boulders are on the surface.

In most areas, the soils in this complex are used as woodland.

These soils are not suited to cultivated crops or to use as pasture. Very steep slopes and surface stones severely restrict the use of farm equipment. The hazard of erosion is very severe.

The potential of Bigfork soil for commercial production of wood products is low and the potential of Carnasaw and Yanush soil is moderate. Shortleaf pine, loblolly pine, and southern red oak are suitable trees. With proper management, Bigfork soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine, Yanush soil has the capability of producing 80 to 92 cubic feet, and Carnasaw soil has the capability of producing 95 to 105 cubic feet. The soils in this complex have severe limitations for equipment use because of very steep slopes and moderate limitations because of surface stones. Because of very steep slopes, erosion is a concern in management. The high content of coarse fragments in the surface layer and subsoil of Bigfork and Yanush soils lowers the available water capacity, which causes moderate seedling mortality.

The soils in this complex are severely limited for most urban uses. Very steep slope is a severe limitation for dwellings, small commercial buildings, local roads and streets, and septic tank absorptions fields. The depth to bedrock of Bigfork soil and the slow permeability of Carnasaw soil are also severe limitations for septic tank absorption fields. These limitations are difficult to overcome and require special design for construction and for installation of sanitary facilities.

These soils are in capability subclass VIIs. Bigfork soil is in woodland suitability group 4R9, Yanush soil is in woodland suitability group 6R9, and Carnasaw soil is in woodland suitability group 7R9.

8—Bismarck-Carnasaw complex, 3 to 8 percent slopes. This complex consists of soils that are gently sloping. They are well drained and somewhat excessively drained. Bismarck soil is shallow, and Carnasaw soil is deep. These soils are loamy and gravelly, and they are on sides and tops of hills. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 10 to 100 acres.

This complex is made up of about 75 percent Bismarck soil, 15 percent Carnasaw soil, and 10 percent other soils.

The typical sequence, depth, and composition of the layers of the Bismarck soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown gravelly silt loam

Subsurface layer:
3 to 7 inches; brown very channery silt loam

Subsoil:
7 to 16 inches; yellowish brown very channery silt loam

Substratum:
16 to 22 inches; red, brown, and gray, partly weathered, tilted shale

Important properties of the Bismarck soil:

Permeability: moderate

Available water capacity: very low

Soil reaction: very strongly acid or strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (soft)

Shrink-swell potential: low

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown gravelly silt loam

Subsurface layer:
2 to 5 inches; yellowish brown gravelly silt loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 26 inches; red silty clay
26 to 32 inches; yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured, partly weathered shale laminated with layers of sandstone, tilted 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: very strongly acid or strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Included in mapping are small areas of shale rock outcrop and some areas of soils similar to Carnasaw soil except they are 20 to 40 inches deep to shale. Also included are small areas of soils that have cobbles on the surface and some areas of soils similar to Bismarck soil except they are 20 to 40 inches deep to bedrock.

In most areas, the soils in this complex are used as woodland or native pasture.

These soils are moderately suited to poorly suited to use as pasture. Bahiagrass, bermudagrass, tall fescue, and native grasses are adapted plants. The very low available water capacity, caused by shallow depth and the content of coarse fragments, restricts the use of Bismarck soil as pasture.

The soils in this complex are poorly suited to cultivated crops because of the severe hazard of erosion.

The potential of Bismarck soil for commercial production of wood products is low, and the potential of Carnasaw soil is moderately high. Shortleaf pine, loblolly pine, white oak, and southern red oak are suitable trees. With proper management, Bismarck soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine, and Carnasaw soil has the capability of producing 108 to 120 cubic feet (fig. 2). Moderate seedling mortality, caused by very low water capacity and shallow rooting depth, is a concern in managing Bismarck soil.

The soils in this complex are moderately suited to poorly suited to most urban uses. These soils have severe limitations for septic tank absorption fields because of the depth to bedrock of Bismarck soil and the slow permeability of Carnasaw soil. Depth to bedrock and slow permeability are difficult to overcome, and a specially designed system is required for septic tank absorption fields. Steepness of slope is a moderate limitation to the use of Bismarck and Carnasaw soils as sites for small commercial buildings. This limitation can generally be overcome by designing structures to conform to the natural slope or by shaping and leveling the site. Depth to bedrock is a moderate limitation to the use of Bismarck soil for dwellings, small commercial buildings, and local roads and streets. This limitation can be avoided by building dwellings and small commercial buildings above bedrock and landscaping with additional fill or by building in areas of the deeper soils within the map unit. High shrink-swell potential is a severe limitation to the use of Carnasaw soil as sites for dwellings, small commercial buildings, and local roads and steets. Providing extra reinforcement, widening footings, and backfilling with sand can help minimize effects of shrinking and swelling. Low strength is also a severe

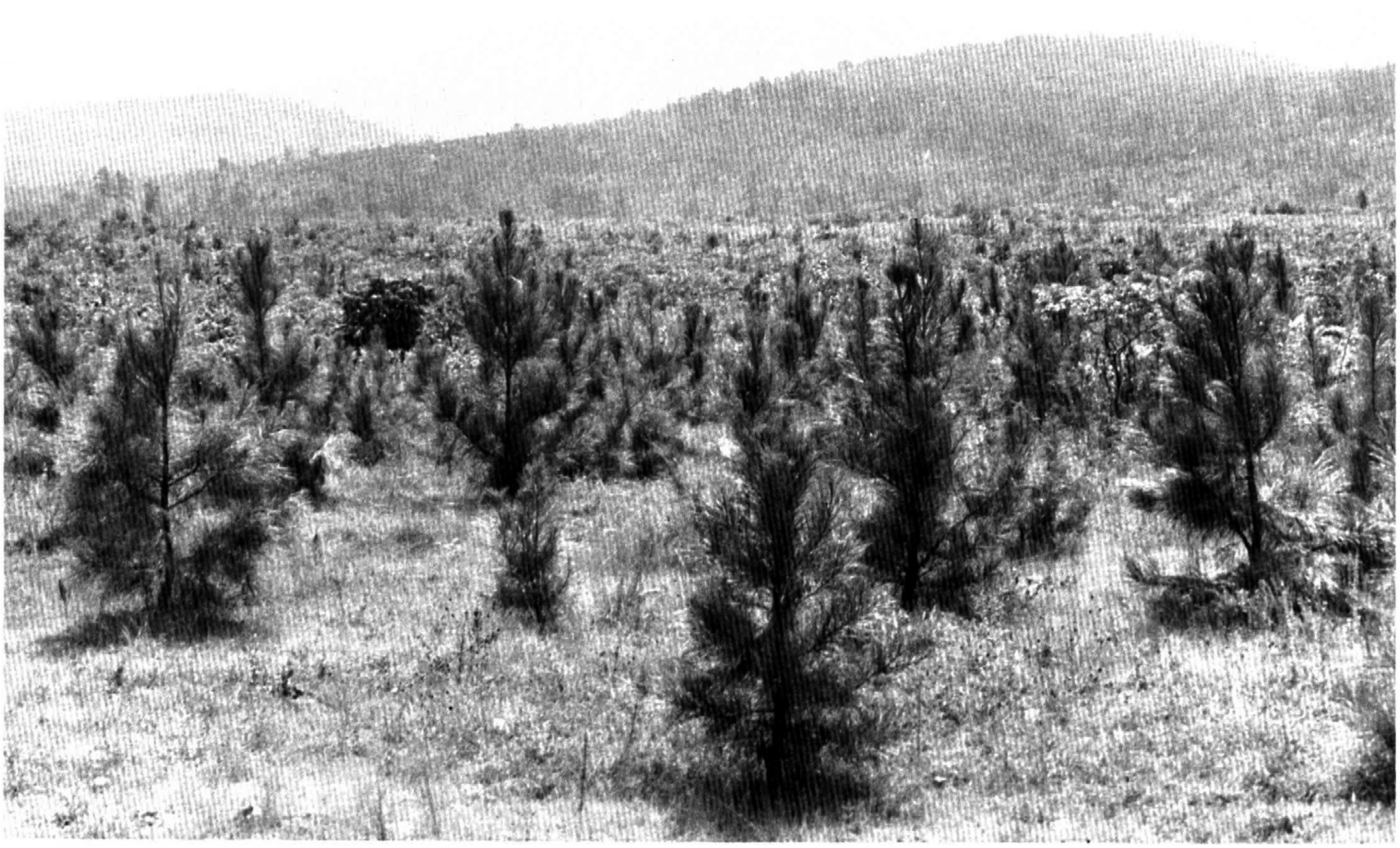


Figure 2.—This stand of young pines on Bismarck-Carnasaw complex, 3 to 8 percent slopes, is managed for optimum productivity.

limitation to the use of Carnasaw soil as sites for roads and streets. Excavating and backfilling with suitable subbase material can help prevent damage to roads and streets where the soil has low strength.

These soils are in capability subclass VIe. Bismarck soil is in woodland suitability group 4D8, and Carnasaw soil is in woodland suitability group 8A7.

9—Bismarck-Carnasaw complex, 8 to 20 percent slopes. This complex consists of soils that are moderately sloping to moderately steep, well drained and somewhat excessively drained. Bismarck soil is shallow, and Carnasaw soil is deep. These soils are loamy and gravelly, and they are on sides and tops of hills. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 10 to 400 acres.

This complex is made up of about 50 percent Bismarck soil, 35 percent Carnasaw soil, and 15 percent other soils.

The typical sequence, depth, and composition of the layers of the Bismarck soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown gravelly silt loam

Subsurface layer:
3 to 7 inches; brown very channery silt loam

Subsoil:
7 to 16 inches; yellowish brown very channery silt loam

Substratum:
16 to 22 inches; red, brown, and gray, partly weathered, tilted shale

Important properties of the Bismarck soil:

Permeability: moderate

Available water capacity: very low

Soil reaction: very strongly acid or strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (soft)

Shrink-swell potential: low

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown gravelly silt loam

Subsurface layer:
2 to 5 inches; yellowish brown gravelly silt loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 26 inches; red silty clay
26 to 32 inches; yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured, partly weathered shale laminated with layers of sandstone, tilted 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: very strongly acid or strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Included in mapping are small areas of shale rock outcrop and some areas of soils similar to Carnasaw soil except they are 20 to 40 inches deep to shale. Also included are small areas of soils that have cobbles on the surface and some areas of soils similar to Bismarck soil except they are 20 to 40 inches deep to bedrock.

In most areas, the soils in this complex are used as woodland or native pasture.

These soils are moderately suited to poorly suited to use as pasture. Bermudagrass, bahiagrass, tall fescue, and native grasses are adapted plants. The very low available water capacity, caused by shallow depth and the content of coarse fragments, restricts the use of Bismarck soil as pasture. Slope is a moderate limitation for both soils.

The soils in this complex are severely limited for cultivated crops. The hazard of erosion is very severe.

The potential of Bismarck soil for the commercial production of wood products is low, and the potential of Carnasaw soil is moderately high. Shortleaf pine, loblolly pine, white oak, and southern red oak are suitable trees. With proper management, Bismarck soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine, and Carnasaw soil has the capability of producing 108 to 120 cubic feet. Moderate seedling mortality, caused by very low available water capacity, is a concern in managing Bismarck soil as woodland.

The soils in this complex are moderately suited to poorly suited to most urban uses. Steepness of slope is a moderate limitation to the use of these soils as sites for dwellings and local roads and streets, and a severe limitation for small commercial buildings. This limitation generally can be overcome by designing structures to conform to the natural slope or by shaping and leveling the site. Depth to bedrock is a moderate limitation to the use of Bismarck soil as sites for dwellings, small commercial buildings, and local roads and streets, and a severe limitation for septic tank absorption fields. The depth to bedrock limitation can be avoided by building above bedrock and landscaping with additional fill or by building in areas of deeper soils within the map unit. High shrink-swell potential is a severe limitation to the use of Carnasaw soil as sites for dwellings, small commercial buildings, and local roads and streets. The low strength of this soil is a severe limitation for local roads and streets, and slow permeability is a severe limitation for septic tank absorption fields. Providing extra reinforcement, widening footings, and backfilling with sand can help to minimize the effects of shrinking and swelling. Where the soil has low strength, excavating and backfilling with suitable subbase material can help prevent damage to roads and streets. Depth to bedrock and slow permeability are difficult to overcome, and a specially designed system is required for septic tank absorption fields.

These soils are in capability subclass VIe. Bismarck soil is in woodland suitability group 4D8, and Carnasaw soil is in woodland suitability group 8A7.

10—Bismarck-Carnasaw complex, 20 to 40 percent slopes. This complex consists of soils that are steep, well drained and somewhat excessively drained.

Bismarck soil is shallow and Carnasaw soil is deep. These soils are loamy and gravelly, and they are on sides of hills. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 500 acres or more.

This complex is made up of about 50 percent Bismarck soil, 35 percent of Carnasaw soil, and 15 percent other soils.

The typical sequence, depth, and composition of the layers of the Bismarck soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown gravelly silt loam

Subsurface layer:
3 to 7 inches; brown very channery silt loam

Subsoil:
7 to 16 inches; yellowish brown very channery silt loam

Substratum:
16 to 22 inches; red, brown, and gray, partly weathered, tilted shale

Important properties of Bismarck soil:

Permeability: moderate

Available water capacity: very low

Soil reaction: very strongly acid or strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (soft)

Shrink-swell potential: low

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown gravelly silt loam

Subsurface layer:
2 to 5 inches; yellowish brown gravelly silt loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 26 inches; red silty clay
26 to 32 inches; yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured, partly weathered shale laminated with layers of sandstone, tilted 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: very strongly acid or strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Included in mapping are small areas of shale rock outcrop and some areas of soils similar to Carnasaw soil except they are 20 to 40 inches deep to shale. Also included are small areas of soils that have cobbles on the surface and soils similar to Bismarck soil except they are 20 to 40 inches deep to bedrock.

In most areas, the soils in this complex are used as woodland.

These soils are poorly suited to use as pasture. Tall fescue and native grasses are adapted plants. The very low available water capacity, caused by shallow depth and the content of coarse fragments, restricts the use of Bismarck soil as pasture. Slope is a severe limitation for both soils.

The soils in this complex are not suited to cultivated crops. Steep slopes severely restrict the use of farm equipment, and the hazard of erosion is very severe.

The potential of Bismarck soil for the commercial production of wood products is low, and the potential of Carnasaw soil is moderately high. Shortleaf pine, loblolly pine, white oak, and southern red oak are suitable trees. With proper management, Bismarck soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine, and Carnasaw soil has the capability of producing 108 to 120 cubic feet. On Bismarck soil, moderate seedling mortality, caused by very low available water capacity, is a concern in management. Slope is a moderate limitation to the use of equipment on both soils.

The soils in this complex have severe limitations for most urban uses. Steepness of slope is a severe limitation for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. Construction on steep slopes generally is more difficult and can require additional expense. Designing structures to conform to the natural slope or shaping and leveling the site can help to minimize the slope limitation. Depth to bedrock is a severe limitation to the use of Bismarck soil for septic tank absorption fields. Depth to bedrock, slow permeability, or steep slopes are difficult to overcome, and a specially designed system can be required for septic tank absorption fields. High shrink-swell potential is a severe limitation to the use of Carnasaw soil as sites for dwellings, small commercial buildings, and local roads and streets. The low strength of this soil is a severe limitation for local roads and streets, and very slow permeability is a severe limitation for septic tank absorption fields. Providing extra reinforcement, widening footings, and backfilling with sand can minimize the effects of shrinking and swelling. Where the soil has low strength, excavating and backfilling with suitable subbase material can help prevent damage to roads and streets.

These soils are in capability subclass VIIe. Bismarck soil is in woodland suitability group 4D8, and Carnasaw soil is in woodland suitability group 8R8.

11—Bismarck-Clebit complex, 40 to 60 percent slopes. This complex consists of soils that are shallow, very steep, well drained and somewhat excessively drained. These soils are loamy, gravelly, and stony. They are on the sides of mountains. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 150 acres.

This complex is made up of about 50 percent Bismarck soil, 30 percent Clebit soil, and 20 percent other soils.

Typically, the Bismarck soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Bismarck soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown gravelly silt loam

Subsurface layer:
3 to 7 inches; brown very channery silt loam

Subsoil:
7 to 16 inches; yellowish brown very channery silt loam

Substratum:
16 to 22 inches; red, brown, and gray, partly weathered shale, tilted and fractured

Important properties of the Bismarck soil:

Permeability: moderate

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (soft)

Shrink-swell potential: low

Typically, the Clebit soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown stony loam

Subsoil:
6 to 12 inches; dark yellowish brown stony loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid to very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Shrink-swell potential: low

Included in mapping are small areas of Carnasaw and Pirum soils, some small areas of sandstone and shale rock outcrop, and some small areas of soils similar to Carnasaw soil except they are 20 to 40 inches deep to shale.

In most areas, the soils in this complex are used as woodland. These soils are better suited to this use.

The soils in this complex are not suited to use as pasture or to cultivated crops because of the rapid runoff, very severe hazard of erosion, very steep slopes, and surface stones.

The potential of Bismarck and Clebit soils for commercial production of wood products is low. Shortleaf pine, eastern redcedar, blackjack oak, post oak, and hickory are suitable trees. With proper management, Bismarck soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine, and Clebit soil has the capability of producing 45 to 50 cubic feet. Very steep slopes is a severe limitation for equipment. The hazard of erosion is a concern because of very steep slopes. Severe seedling mortality, caused by restricted rooting depth and very low available water capacity, is also a concern in managing Bismarck and Clebit soils.

Bismarck and Clebit soils have severe limitations for most urban uses. Steepness of slope is a severe limitation for dwellings, septic tank absorption fields, small commercial buildings, and local roads and streets. Shallow depth to bedrock is also a limitation for most urban uses. These limitations are difficult to overcome and require special designs for construction or for installation of sanitary facilities.

These soils are in capability subclass VIIs. Bismarck soil is in woodland suitability group 4R9, and Clebit soil is in woodland suitability group 3R9.

12—Bismarck-Clebit-Sherless complex, 3 to 8 percent slopes. This complex consists of soils that are gently sloping, somewhat excessively drained and well drained. Bismarck and Clebit soils are shallow, and Sherless soil is moderately deep. These soils are gravelly, and they are on sides and tops of hills. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas range from about 10 to 200 acres.

This complex is made up of about 40 percent Bismarck soil, 30 percent Clebit soil, 20 percent Sherless soil, and 10 percent other soils.

The typical sequence, depth, and composition of the layers of the Bismarck soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown gravelly silt loam

Subsurface layer:
3 to 7 inches; brown very channery silt loam

Subsoil:
7 to 16 inches; yellowish brown very channery silt loam

Substratum:
16 to 22 inches; red, brown, and gray, partly weathered, tilted shale

Important properties of the Bismarck soil:

Permeability: moderate

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (soft)

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown very gravelly loam

Subsoil:
6 to 12 inches; dark yellowish brown very gravelly loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

The typical sequence, depth, and composition of the layers of the Sherless soil are as follows:

Surface layer:
0 to 5 inches; dark brown gravelly fine sandy loam

Subsurface layer:
5 to 11 inches; light yellowish brown gravelly fine sandy loam

Subsoil:
11 to 26 inches; yellowish red clay loam
26 to 39 inches; yellowish red gravelly sandy clay loam

Substratum:
39 to 42 inches; red, brown, and gray, fractured, soft, weathered sandstone

Important properties of the Sherless soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (soft)

Included in mapping are small areas of Carnasaw soils. Also included are some small areas of soils that have cobbles on the surface and soils similar to Sherless soil except they are 10 to 20 inches deep to soft sandstone.

In most areas, the soils of this complex are used as woodland or native pasture.

The soils in this complex are poorly suited to use as pasture and are severely limited for cultivated crops. Bismarck and Clebit soils have very low available water capacity because of shallow depth and content of coarse fragments in the subsoil. In addition, the hazard of erosion is severe. Where these soils are used as pasture, however, fescue and native grasses generally are better adapted.

The potential of Bismarck and Clebit soils for commercial production of wood products is low, and the potential of Sherless soil is moderately high. Shortleaf pine, eastern redcedar, white oak, and southern red oak are suitable trees. With proper management, Bismarck soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine, Clebit soil has the capability of producing 45 to 50 cubic feet, and Sherless soil has the capability of producing 108 to 122 cubic feet. Moderate to severe seedling mortality, caused by very low available water capacity and shallow rooting depth, is a concern in managing Bismarck and Clebit soils as woodland.

The soils in this complex are moderately suited to poorly suited to most urban uses. Depth to bedrock is a severe limitation for septic tank absorption fields, and steepness of slope is a moderate limitation for small commercial buildings. The steepness of slope limitation can be minimized by designing structures to conform to the natural slope or by shaping and leveling the site. Depth to bedrock limitations for septic tank absorption fields generally are difficult to overcome, and a specially designed system is required. Depth to bedrock is also a moderate limitation to the use of Bismarck soil as sites for dwellings and local roads and streets, and a severe limitation to the use of Clebit soil as sites for dwellings, small commercial buildings, and local roads and streets. The depth to bedrock limitation for dwellings and small commercial buildings can be avoided by building in areas of deeper soils within the map unit or by building above bedrock and landscaping with additional fill.

These soils are in capability subclass VIe. Bismarck soil is in woodland suitability group 4D8, Clebit soil is in woodland suitability group 3D9, and Sherless soil is in woodland suitability group 8A7.

13—Bismarck-Sherless-Clebit complex, 8 to 12 percent slopes. This complex consists of soils that are moderately sloping, somewhat excessively drained and well drained. Bismarck and Clebit soils are shallow, and Sherless soil is moderately deep. These soils are gravelly and very gravelly, and they are on sides and tops of hills. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 200 acres.

This complex is made up of about 40 percent Bismarck soil, 30 percent Sherless soil, 20 percent Clebit soil, and 10 percent other soils.

The typical sequence, depth, and composition of the layers of the Bismarck soil are as follows:

Surface layer:
0 to 3 inches, dark grayish brown gravelly silt loam

Subsurface layer:
3 to 7 inches; brown very channery silt loam

Subsoil:
7 to 16 inches; yellowish brown very channery silt loam

Substratum:
16 to 22 inches; red, brown, and gray, partly weathered, tilted shale

Important properties of the Bismarck soil:

Permeability: moderate

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (soft)

The typical sequence, depth, and composition of the layers of the Sherless soil are as follows:

Surface layer:
0 to 5 inches; dark brown gravelly fine sandy loam

Subsurface layer:
5 to 11 inches; light yellowish brown gravelly fine sandy loam

Subsoil:
11 to 26 inches; yellowish red clay loam
26 to 39 inches; yellowish red gravelly sandy clay loam

Substratum:
39 to 42 inches; red, brown, and gray, fractured, soft, weathered sandstone

Important properties of the Sherless soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (soft)

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown very gravelly loam

Subsoil:
6 to 12 inches; dark yellowish brown very gravelly loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Included in mapping are small areas of Carnasaw soils. Also included are some small areas of soils that have cobbles on the surface and soils similar to Sherless soil except they are 10 to 20 inches deep to soft sandstone.

In most areas, the soils in this complex are used as woodland or native pasture.

These soils are poorly suited to use as pasture and are severely limited for cultivated crops. Bismarck and Clebit soils have very low available water capacity because of shallow depth and the content of coarse fragments in the subsoil. In addition, the hazard of erosion is very severe. Where these soils are used as pasture, however, fescue and native grasses generally are better adapted.

The potential of Bismarck and Clebit soils for commercial production of wood products is low, and the potential of Sherless soil is moderately high. Shortleaf pine, loblolly pine, white oak, and southern red oak are suitable trees. With proper management, Bismarck soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine, Clebit soil has the capability of producing 45 to 50 cubic feet, and Sherless soil has the capability of producing 108 to 122 cubic feet. Moderate to severe seedling mortality, caused by very low available water capacity and shallow rooting depth, is a concern in managing Bismarck and Clebit soils as woodland.

The soils in this complex are moderately suited to poorly suited to most urban uses. Depth to bedrock is a severe limitation to the use of all the soils as sites for septic tank absorption fields; a moderate limitation to the use of Bismarck soil as sites for dwellings and local roads and streets; and a severe limitation to the use of Clebit soil as sites for dwellings, small commercial buildings, and local roads and streets. The depth to bedrock limitation for dwellings and small commercial buildings can be avoided by building in areas of deeper soils in the map unit or by building above bedrock and landscaping with additional fill. Depth to bedrock and slope limitations for septic tank absorption fields are difficult to overcome, and a specially designed system generally is required. Steepness of slope is a severe limitation to the use of all the soils as sites for small commercial buildings and a moderate limitation for dwellings and local roads and streets. This limitation can be minimized by designing structures to conform to the natural slope or by shaping and leveling the site.

These soils are in capability subclass VIe. Bismarck soil is in woodland suitability group 4D8, Sherless soil is in woodland suitability group 8A7, and Clebit soil is in woodland suitability group 3D9.

14—Bismarck-Sherless-Clebit complex, 12 to 30 percent slopes. This complex consists of soils that are moderately steep to steep, somewhat excessively drained and well drained. Bismarck and Clebit soils are shallow, and Sherless soil is moderately deep. These soils are gravelly and very gravelly, and they are on sides and tops of hills. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 400 acres.

This complex is made up of about 40 percent Bismarck soil, 30 percent Sherless soil, 20 percent Clebit soil, and 10 percent other soils.

The typical sequence, depth, and composition of the layers of the Bismarck soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown gravelly silt loam

Subsurface layer:
3 to 7 inches; brown very channery silt loam

Subsoil:
7 to 16 inches; yellowish brown very channery silt loam

Substratum:
16 to 22 inches; red, brown, and gray, partly weathered, tilted shale

Important properties of the Bismarck soil:

Permeability: moderate

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (soft)

The typical sequence, depth, and composition of the layers of the Sherless soil are as follows:

Surface layer:
0 to 5 inches; dark brown gravelly fine sandy loam

Subsurface layer:
5 to 11 inches; light yellowish brown gravelly fine sandy loam

Subsoil:
11 to 26 inches; yellowish red clay loam
26 to 39 inches; yellowish red gravelly sandy clay loam

Substratum:
39 to 42 inches; red, brown, and gray, fractured, soft, weathered sandstone

Important properties of the Sherless soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (soft)

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown very gravelly loam

Subsoil:
6 to 12 inches; dark yellowish brown very gravelly loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Included in mapping are small areas of Carnasaw soils. Also included are some small areas of soils that have cobbles on the surface and soils similar to Sherless soil except they are 10 to 20 inches deep to soft sandstone.

In most areas, the soils of this complex are used as woodland.

These soils are poorly suited to use as pasture and are not suited to cultivated crops. The hazard of erosion is very severe. Bismarck and Clebit soils have very low available water capacity because of shallow depth and the content of coarse fragments in the subsoil. Slope is a limitation for use of equipment on the steeper soils. Where these soils are used as pasture, however, fescue and native grasses generally are better adapted.

The potential of Bismarck and Clebit soils for commercial production of wood products is low, and the potential of Sherless soil is moderately high. Shortleaf pine, loblolly pine, white oak, and southern red oak are suitable trees. With proper management, Bismarck soil has the capability of producing 50 to 65 cubic feet per acre per year of shortleaf pine, Clebit soil has the capability of producing 45 to 50 cubic feet, and Sherless soil has the capability of producing 108 to 122 cubic feet. Moderate to severe seedling mortality, caused by very low available water capacity and shallow rooting depth, is a concern in managing Bismarck and Clebit soils as woodland. Slope is also a moderate limitation to the use of equipment on these soils.

The soils in this complex are poorly suited to most urban uses. Depth to bedrock is a severe limitation to the use of all the soils as sites for septic tank absorption fields; a moderate limitation to the use of Bismarck soil as sites for dwellings and local roads and streets; and a severe limitation to the use of Clebit soil as sites for dwellings, small commercial buildings, and local roads and streets. The depth to bedrock limitation for dwellings and small commercial buildings can be avoided by building in areas of deeper soils within the map unit or by building above bedrock and landscaping with additional fill. Depth to bedrock and slope limitations for septic tank absorption fields generally are difficult to overcome and require a specially designed system. Steepness of slope is a severe limitation to the use of all the soils as sites for septic tank absorption fields, dwellings, small commercial buildings, and local roads and streets. This limitation can be minimized by designing structures to conform to the natural slope or by shaping and leveling the site.

These soils are in capability subclass VIIe. Bismarck soil is in woodland suitability group 4D8, Sherless soil is in woodland suitability group 8R8, and Clebit soil is in woodland suitability group 3D9.

15—Bonnerdale fine sandy loam, occasionally flooded. This soil is deep, level to nearly level, and somewhat poorly drained. It is in upland drainageways. Periods of flooding are brief from December to April. The areas of this soil range from about 10 to 100 acres or more. The slopes range from about 0 to 2 percent.

The typical sequence, depth, and composition of the layers of this Bonnerdale soil are as follows:

Surface layer:
0 to 6 inches; yellowish brown fine sandy loam

Subsoil:
6 to 17 inches; yellowish brown mottled loam
17 to 32 inches; mottled yellowish brown, light brownish gray, and light yellowish brown loam
32 to 44 inches; yellowish brown mottled loam
44 to 50 inches; pale brown mottled loam
50 to 54 inches; gray, mottled channery clay loam

Substratum:
54 to 60 inches; weathered, fractured shale, tilted 45 degrees from horizontal

Important properties of this Bonnerdale soil:

Permeability: moderate

Available water capacity: high

Soil reaction: strongly acid or very strongly acid

Surface runoff: slow

High water table: perched at a depth of 6 to 12 inches from December to May

Depth to bedrock: 40 to 60 inches (soft)

Included with this soil in mapping are small areas of Ceda, Mazarn, and Spadra soils. Also included are small areas of soils where flooding is not a hazard or it is rare.

This Bonnerdale soil is mainly used as pasture.

This soil is well suited to use as pasture. Common bermudagrass, tall fescue, bahiagrass, white clover, sericea lespedeza, and annual lespedeza are adapted pasture plants. Occasional flooding is a moderate hazard. Appropriate management practices include deferred grazing, rotation grazing, controlling weeds and brush, and proper stocking.

This soil is moderately suited to cultivated crops. Soybeans, grain sorghum, and corn are adapted crops. Occasional flooding is a hazard, and wetness is a limitation to crop production. Adequate surface drainage is needed to remove excess water.

The potential of Bonnerdale soil for commercial production of wood products is moderately high. Loblolly pine, shortleaf pine, and sweetgum are suitable trees. With proper management, this soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine. Wetness is a moderate limitation to the use of equipment.

This soil is poorly suited to most urban uses. Occasional flooding is a hazard and wetness is a severe limitation to the use of this soil as sites for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. Flooding and wetness generally are difficult or impractical to overcome. Some included soils or soils in other map units are better suited to most urban uses.

This Bonnerdale soil is in capability subclass IIIw and in woodland suitability group 8W8.

16—Carnasaw gravelly silt loam, 3 to 8 percent slopes. This soil is deep, gently sloping, and well drained. It is on the sides and tops of hills and mountains. The areas of this soil range from 10 to 100 acres. The slopes generally are convex.

The typical sequence, depth, and composition of the layers of this Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown gravelly silt loam

Subsurface layer:
2 to 5 inches; yellowish brown gravelly silt loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 26 inches; red silty clay
26 to 32 inches; yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:

42 to 50 inches; fractured shale bedrock laminated with layers of sandstone, tilted 30 degrees from horizontal

Important properties of this Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Included with this soil in mapping are small areas of Bismarck and Pirum soils. Also included are some areas of soils that have slopes of more than 8 percent and soils similar to Carnasaw soil except they are less than 40 inches to bedrock.

This Carnasaw soil is mainly used as pasture.

This soil is well suited to use as pasture (fig. 3). Bermudagrass, bahiagrass, tall fescue, and white clover are adapted pasture plants. Appropriate management practices are proper stocking, controlled grazing, maintaining the fertility level, and controlling brush and weeds.

This soil is poorly suited to cultivated crops. The hazard of erosion is very severe. Conservation tillage, terraces, contour farming, and cover crops reduce runoff and help to control erosion.

The potential of Carnasaw soil for commercial production of wood products is moderately high. Loblolly pine, shortleaf pine, southern red oak, and white oak are adapted trees. With proper management, this soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine. This soil can be subject to rutting during wet periods.

This soil is poorly suited to most urban uses. High shrink-swell potential is a severe limitation to use of this soil as sites for dwellings and small commercial buildings. This limitation can be minimized or corrected by using wider footings and extra reinforcement and by excavating and backfilling with sand beneath the footings. High shrink-swell potential and low strength are severe limitations for local roads and streets. Damage caused by these limitations can be prevented by excavating and backfilling with sand and using a suitable subbase material. Slow permeability is a severe limitation for septic tank absorption fields. This limitation is difficult to overcome, and a specially designed system generally is required.

This Carnasaw soil is in capability subclass IVe and in woodland suitability group 8A7.

17—Carnasaw gravelly silt loam, 8 to 20 percent slopes. This soil is deep, moderately sloping to moderately steep, and well drained. It is on sides of hills and mountains. The areas of this soil range from 10 to 100 acres. The slopes generally are convex.

The typical sequence, depth, and composition of the layers of this Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown gravelly silt loam

Subsurface layer:
2 to 5 inches; yellowish brown gravelly silt loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 26 inches; red silty clay
26 to 32 inches; yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured shale bedrock laminated with layers of sandstone, tilted 30 degrees from horizontal

Important properties of this Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Included with this soil in mapping are small areas of Bismarck and Pirum soils. Also included are some areas of soils that have cobbles on the surface and soils similar to Carnasaw soil except they are less than 40 inches to bedrock.

This Carnasaw soil is mainly used as woodland or native pasture.

This soil is moderately suited to use as pasture. Bermudagrass, bahiagrass, tall fescue, and white clover are adapted pasture plants. Appropriate management practices are proper stocking, controlled grazing, maintaining the fertility level, and controlling brush and weeds.

Figure 3.—Carnasaw gravelly silt loam, 3 to 8 percent slopes, is well suited to use as pasture.

This soil is not suited to cultivated crops. The hazard of erosion is very severe, and moderately steep slopes restrict the use of some farm equipment.

The potential of Carnasaw soil for commercial production of wood products is moderately high. Loblolly pine, shortleaf pine, southern red oak, and white oak are suitable trees. With proper management, this soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine. The soil can be subject to rutting during wet periods.

This soil is poorly suited to most urban uses. High shrink-swell potential is a severe limitation to use of this soil as sites for dwellings and small commercial buildings. This limitation can be minimized or corrected by using wider footings and extra reinforcement and by excavating and backfilling with sand beneath the footings. Slope is a moderate limitation for dwellings and a severe limitation for small commercial buildings. High shrink-swell potential and low strength are severe limitations for local roads and streets. Damage caused by these limitations can be prevented by excavating and backfilling with sand and using a suitable subbase material. Slow permeability is a severe limitation for septic tank absorption fields. This limitation is difficult to overcome, and a specially designed system generally is required.

This Carnasaw soil is in capability subclass VIe and in woodland suitability group 8A7.

18—Carnasaw-Clebit complex, 3 to 15 percent slopes. This complex consists of soils that are gently sloping to moderately sloping and well drained. Carnasaw soil is deep, and Clebit soil is shallow. These soils are stony, and they are on tops of mountains. Stones, cobbles, and gravel are on the surface. Stones are the most limiting feature. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 200 acres.

This complex is made up of about 60 percent Carnasaw soil, 25 percent Clebit soil, and 15 percent other soils.

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown stony loam

Subsurface layer:
2 to 5 inches; yellowish brown stony loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 32 inches; red and yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured, soft, partly weathered shale, tilted about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Typically, the Clebit soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown stony loam

Subsoil:
6 to 12 inches; dark yellowish brown stony loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Shrink-swell potential: low

Included in mapping are small areas of Bismarck and Pirum soils and soils similar to Carnasaw soil except they are less than 40 inches to bedrock.

In most areas, the soils in this complex are used as woodland.

These soils are not suited to cultivated crops and are severely limited for use as pasture. Surface stones limit the use of farm equipment, and the hazard of erosion is very severe. Clebit soils also have very low available water capacity caused by shallow depth to bedrock.

The potential of Carnasaw soil for commercial production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, southern red oak, post oak, and hickory are suitable trees. With proper management, Carnasaw soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine, and Clebit soil has the capability of producing 45 to 50 cubic feet. The soils in this complex have moderate to severe limitations for use of equipment because of surface stones. Severe seedling mortality and the restricted rooting depth of Clebit soil are concerns in management. Also, Carnasaw soil is subject to rutting during wet periods.

The soils in this complex are poorly suited to most urban uses. Steepness of slope is a moderate limitation for dwellings, local roads and streets, and septic tank absorption fields, and a severe limitation for small commercial buildings. This limitation can be minimized by adapting the design to conform to the natural slope or by shaping and leveling the site. High shrink-swell potential is a severe limitation to the use of Carnasaw soil as sites for dwellings, small commercial buildings, and local roads and streets. The slow permeability of this soil is a severe limitation for septic tank absorption fields, and low strength is a severe limitation for local roads and streets. Wider footings, extra reinforcement, and excavating and backfilling with sand help to minimize the effects of shrinking and swelling. Providing suitable subgrade or base material for roads and streets can help to prevent damage caused by low strength. Depth to bedrock is a severe limitation to the use of Clebit soil as sites for septic tank absorption fields, dwellings, small commercial buildings, and local roads and streets. This limitation for dwellings and small commercial buildings can be avoided by building above the bedrock and landscaping with additional fill or by building in areas of deeper soils within the map unit. Depth to bedrock and slow permeability limitations for septic tank absorption fields are difficult to overcome, and a specially designed system generally is required.

These soils are in capability subclass VIIs. Carnasaw soil is in woodland suitability group 8X8, and Clebit soil is in woodland suitability group 3X9.

19—Carnasaw-Pirum complex, 3 to 8 percent slopes. This complex consists of soils that are gently sloping and well drained. Carnasaw soil is deep, and Pirum soil is moderately deep. These soils are cobbly and are on foot slopes of hills and mountains. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 40 to 200 acres.

This complex is made up of about 50 percent Carnasaw soil, 30 percent Pirum soil, and 20 percent other soils.

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown cobbly loam

Subsurface layer:
2 to 5 inches; yellowish brown cobbly loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 32 inches; red and yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured, soft, partly weathered shale, tilted about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Typically, the Pirum soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Pirum soil are as follows:

Surface layer:
0 to 4 inches; dark brown cobbly loam

Subsurface layer:
4 to 10 inches; light yellowish brown loam

Subsoil:
10 to 25 inches; yellowish brown loam
25 to 40 inches; strong brown clay loam

Substratum:
40 to 50 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal.

Important properties of the Pirum soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Shrink-swell potential: low

Depth to bedrock: 22 to 50 inches (hard)

Included in mapping are small areas of Bismarck soils, Clebit soils, and soils similar to Carnasaw soil except they are less than 40 inches to bedrock.

In most areas, the soils in this complex are used as woodland or native pasture.

These soils are moderately suited to use as pasture. Bermudagrass, bahiagrass, tall fescue, and white clover are adapted plants. Cobble-size fragments on the surface are a moderate limitation for equipment use. Appropriate management practices include proper stocking, controlled grazing, maintaining the fertility level, and controlling weeds and brush.

The soils in this complex are poorly suited to cultivated crops. Cobble-size fragments on the surface interfere with tillage operations, and the hazard of erosion is very severe. Conservation tillage, contour farming, and cover crops reduce runoff and help to control erosion.

The potential of Pirum and Carnasaw soil for commercial production of wood products is moderately high (fig. 4). Shortleaf pine, loblolly pine, southern red oak, post oak, and hickory are suitable trees. With proper management, these soils have the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine. Cobble-size fragments on the surface are a moderate limitation for equipment use.

The soils in this complex are moderately suited to poorly suited to most urban uses. High shrink-swell potential is a severe limitation to the use of Carnasaw soil as sites for dwellings, small commercial buildings, and local roads and streets. The low strength of this soil is a severe limitation for local roads and streets, and slow permeability is a severe limitation for septic tank absorption fields. Wider footings, extra reinforcement,

Figure 4.—Shortleaf pine is grown for commercial production on Carnasaw-Pirum complex, 3 to 8 percent slopes.

and excavating and backfilling with sand help to minimize the effects of shrinking and swelling. Providing suitable subgrade or base material for roads and streets can help to prevent damage caused by low strength. Depth to bedrock is a moderate limitation to the use of Pirum soil as sites for dwellings, small commercial buildings, and local roads and streets and is a severe limitation for septic tank absorption fields. The depth to bedrock limitation for dwellings and small commercial buildings can be avoided by building above the bedrock and landscaping with additional fill or by building in areas of deeper soils within the map unit. Depth to bedrock limitations for septic tank absorption fields are difficult to overcome and generally require a specially designed system. Steepness of slope is a moderate limitation to the use of Pirum soil as sites for small commercial buildings. The slope limitation can be minimized by designing the structure to conform to the natural slope or by shaping and leveling the site.

The soils in this map unit are in capability subclass IVe and in woodland suitability group 8X8.

20—Carnasaw-Pirum complex, 8 to 20 percent slopes. This complex consists of soils that are moderately sloping to moderately steep and well drained. Carnasaw soil is deep, and Pirum soil is moderately deep. These soils are loamy and cobbly, and they are on sides and foot slopes of hills and mountains. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 40 to 200 acres.

This complex is made up of about 50 percent Carnasaw soil, 30 percent Pirum soil, and 20 percent other soils.

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown cobbly loam

Subsurface layer:
2 to 5 inches; yellowish brown cobbly loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 32 inches; red and yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured, soft, partly weathered shale, tilted about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Typically, the Pirum soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Pirum soil are as follows:

Surface layer:
0 to 4 inches; dark brown cobbly loam

Subsurface layer:
4 to 10 inches; light yellowish brown loam

Subsoil:
10 to 25 inches; yellowish brown loam
25 to 40 inches; strong brown clay loam

Substratum:
40 to 50 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Pirum soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 22 to 50 inches (hard)

Shrink-swell potential: low

Included in mapping are small areas of Bismarck soils, Clebit soils, and soils similar to Carnasaw soil except they are less than 40 inches to bedrock.

In most areas, the soils in this complex are used as woodland or native pasture.

These soils are moderately suited to use as pasture. Bermudagrass, bahiagrass, tall fescue, and white clover are adapted pasture plants. Cobble-size fragments on the surface are a moderate limitation for equipment use.

Moderately steep slopes can also restrict the use of farm equipment. Appropriate management practices include proper stocking, controlled grazing, maintaining the fertility level, and controlling weeds and brush.

The soils in this complex are severely limited for cultivated crops. The hazard of erosion is very severe. Cobble-size fragments on the surface and moderately steep slopes restrict tillage operations.

The potential of Pirum and Carnasaw soils for commercial production of wood products is moderately high. Shortleaf pine, loblolly pine, southern red oak, post oak, and hickory are suitable trees. With proper management, these soils have the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine. Cobble-size fragments on the surface are a moderate limitation for equipment use.

The soils in this complex are moderately suited to poorly suited to most urban uses. High shrink-swell potential is a severe limitation to the use of Carnasaw soil as sites for dwellings, small commercial buildings, and local roads and streets. Wider footings, extra reinforcement, and excavating and backfilling with sand help to minimize the effects of shrinking and swelling. The low strength of the Carnasaw soil is a severe limitation for local roads and streets, and slow permeability is a severe limitation for septic tank absorption fields. Steepness of slope and depth to bedrock are moderate limitations to the use of Pirum soil as sites for dwellings and local roads and streets, and severe limitations for septic tank absorption fields and small commercial buildings. Providing suitable subgrade or base material for roads and streets help to prevent damage caused by low strength. The slope limitation can be minimized by designing structures to conform to the natural slope or by shaping and leveling the site. The depth to bedrock limitation for dwellings and small commercial buildings can be avoided by building above the bedrock and landscaping with additional fill or by building in areas of deeper soils within the map unit. Depth to bedrock and slow permeability limitations for septic tank absorption fields are difficult to overcome and generally require a specially designed system.

The soils in this map unit are in capability subclass VIe and in woodland suitability group 8X8.

21—Carnasaw-Pirum-Clebit complex, 20 to 40 percent slopes. This complex consists of soils that are steep and well drained. Carnasaw soil is deep, Pirum soil is moderately deep, and Clebit soil is shallow. These soils are stony, and they are on the sides of mountains. Stones, cobbles, and gravel are on the surface. Stones are the most limiting feature. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 80 to more than 500 acres.

This complex is made up of about 50 percent Carnasaw soil, 25 percent Pirum soil, 15 percent Clebit soil, and 10 percent other soils.

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown stony loam

Subsurface layer:
2 to 5 inches; yellowish brown stony loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 32 inches; red and yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; soft, partly weathered shale, tilted about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Typically, the Pirum soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Pirum soil are as follows:

Surface layer:
0 to 4 inches; dark brown stony loam

Subsurface layer:
4 to 10 inches; light yellowish brown loam

Subsoil:
10 to 25 inches; yellowish brown loam
25 to 40 inches; strong brown clay loam

Substratum:
40 to 50 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Pirum soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 22 to 50 inches (hard)

Shrink-swell potential: low

Typically, the Clebit soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown stony loam

Subsoil:
6 to 12 inches; dark yellowish brown stony loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Shrink-swell potential: low

Included in mapping are Bismarck soils, soils similar to Carnasaw soil except they are less than 40 inches to bedrock, areas of soils that have a very stony surface layer, and small areas of rock outcrop.

In most areas, the soils in this complex are used as woodland.

These soils are not suited to cultivated crops and are severely limited for use as pasture. Slope and surface stones severely restrict the use of farm equipment. In addition, the hazard of erosion is very severe.

The potential of Carnasaw and Pirum soils for commercial production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, southern red oak, post oak, and hickory are suitable trees. With proper management, Carnasaw and Pirum soils have the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine, and Clebit soil has the capability of producing 45 to 50 cubic feet. The soils in this complex have moderate to severe limitations for equipment use because of steep slopes and surface stones that can restrict the use of rubber-tired skidders. Erosion is also a concern because of steep slopes. The rooting depth of Clebit soil is restricted, and Carnasaw soil is subject to rutting during wet periods. Seedling mortality is severe on Clebit soil, but it can be reduced by limiting soil compaction so that the infiltration rate for critical summer rains remains high.

The soils in this complex are poorly suited to most urban uses. Steepness of slope is a severe limitation for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. High shrink-swell potential is a severe limitation to the use of Carnasaw soil as sites for dwellings, small commercial buildings, and local roads and streets. The slow permeability of this soil is a severe limitation for septic tank absorption fields, and low strength is a severe limitation for local roads and streets. Depth to bedrock is a severe limitation to the use of Clebit and Pirum soils as sites for septic tank absorption fields, and a severe limitation to the use of Clebit soil as sites for dwellings, small commercial buildings, and local roads and streets. These limitations are difficult to overcome and require special designs for construction and for installation of sanitary facilities.

These soils are in capability subclass VIIs. Carnasaw and Pirum soils are in woodland suitability group 8X8, and Clebit soil is in woodland suitability group 3X9.

22—Carnasaw-Pirum-Clebit complex, 40 to 60 percent slopes. This complex consists of soils that are very steep and well drained. Carnasaw soil is deep, Pirum soil is moderately deep, and Clebit soil is shallow. These soils are stony, and they are on the sides of mountains. Stones, cobbles, and gravel are on the surface. Stones are the most limiting feature. These soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 80 to 300 acres.

This complex is made up of about 50 percent Carnasaw soil, 20 percent Pirum soil, 15 percent Clebit soil, and 15 percent other soils.

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown stony loam

Subsurface layer:
2 to 5 inches; yellowish brown stony loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 32 inches; red and yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; soft, partly weathered shale, tilted at about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Typically, the Pirum soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Pirum soil are as follows:

Surface layer:
0 to 4 inches; dark brown stony loam

Subsurface layer:
4 to 10 inches; light yellowish brown loam

Subsoil:
10 to 25 inches; yellowish brown loam
25 to 40 inches; strong brown clay loam

Substratum:
40 to 50 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Pirum soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 22 to 50 inches (hard)

Shrink-swell potential: low

Typically, the Clebit soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown stony loam

Subsoil:
6 to 12 inches; dark yellowish brown stony loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Shrink-swell potential: low

Included in mapping are soils similar to Carnasaw soil except some are deeper than 60 inches to bedrock and some are less than 40 inches to bedrock. Some small areas of soils that have a very stony surface layer and small areas of rock outcrop are also included.

In most areas, the soils in this complex are used as woodland.

These soils are not suited to cultivated crops or to use as pasture. Slope and surface stones severely restrict the use of farm equipment, and the hazard of erosion is very severe.

The potential of Carnasaw and Pirum soils for commercial production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, southern red oak, post oak, and hickory are suitable trees. With proper management, Carnasaw soil has the capability of producing 105 cubic feet per acre per year of shortleaf pine, Pirum soil has the capability of producing 108 to 120 cubic feet, and Clebit soil has the capability of producing 45 to 50 cubic feet. The soils in this complex have severe limitations to use of equipment because of very steep slopes. Surface stones also restrict the use of some equipment. The hazard of erosion is a concern because of the very steep slopes. Other concerns in managing Clebit soil as woodland are the restrictive rooting depth and seedling mortality.

The soils in this complex are severely limited for most urban uses. Very steep slope is a severe limitation for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. High shrink-swell potential is a severe limitation to the use of Carnasaw soil as sites for dwellings, small commercial buildings, and local roads and streets. The slow permeability of this soil is a severe limitation for septic tank absorption fields, and low strength is a severe limitation for local roads and streets. Depth to bedrock is a severe limitation to the use of Clebit and Pirum soils as sites for septic tank absorption fields, and to the use of Clebit soil as sites for dwellings, small commercial buildings, and local roads and streets. These limitations are difficult to overcome and require special designs for construction and for installation of sanitary facilities.

These soils are in capability subclass VIIs. Carnasaw soil is in woodland suitability group 7R9, Pirum soil is in woodland suitability group 8R9, and Clebit soil is in woodland suitability group 3R9.

23—Ceda gravelly loam, frequently flooded. This soil is deep, level to nearly level, and well drained. It is on flood plains. Periods of flooding generally occur from December to June and are very brief. The areas of this soil range from about 10 to 300 acres or more. The slopes range from 0 to 3 percent.

The typical sequence, depth, and composition of the layers of this Ceda soil are as follows:

Surface layer:
0 to 6 inches; dark brown gravelly loam

Substratum:
6 to 72 inches; yellowish brown very gravelly loam

Important properties of this Ceda soil:

Permeability: rapid

Available water capacity: very low

Soil reaction: medium acid

Surface runoff: slow

High water table: none within a depth of 6 feet

Depth to bedrock: more than 60 inches

Included with this soil in mapping are a few small areas of Bonnerdale, Leadvale, Mazarn, and Spadra soils. Also included are small areas of soils that have a cobbly surface layer, and soils similar to Ceda soil except the reaction is more acid throughout the profile.

This Ceda soil is mainly used as woodland.

This soil is poorly suited to use as pasture and is not suited to cultivated crops. Frequent flooding, droughtiness, and coarse fragments are severe limitations to the use and management of this soil.

The potential of this soil for commercial production of wood products is moderately high. Shortleaf pine, loblolly pine, southern red oak, white oak, and American sycamore are suitable trees. With proper management, this soil has the capability of producing 95 to 106 cubic feet per acre per year of shortleaf pine. Seedling mortality, caused by the very low available water capacity, is moderate.

This soil is severely limited for urban uses. Frequent flooding is a severe hazard for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. Flooding generally is difficult or impractical to overcome without major flood control. Poor filtration is a severe limitation for septic tank absorption fields.

This Ceda soil is in capability subclass VIIs and in woodland suitability group 7F8.

24—Clebit-Pirum-Rock outcrop complex, 3 to 15 percent slopes. This complex consists of Rock outcrop and soils that are well drained, bouldery, and very stony. Clebit soil is shallow, and Pirum soil is moderately deep. These soils and Rock outcrop are on the tops of mountains. Rock outcrop, boulders, stones, cobbles, and gravel are on the surface. Rock outcrop, boulders, and stones are the most limiting features. These soils and Rock outcrop were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to more than 200 acres.

This complex consists of about 40 percent Clebit soil, 25 percent Pirum soil, 20 percent Rock outcrop, and 15 percent other soils.

Typically, the Clebit soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown bouldery loam

Subsoil:
6 to 12 inches; dark yellowish brown stony loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Shrink-swell potential: low

Typically, the Pirum soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Pirum soil are as follows:

Surface layer:
0 to 4 inches; dark brown very stony loam

Subsurface layer:
4 to 10 inches; light yellowish brown loam

Subsoil:
10 to 25 inches; yellowish brown loam
25 to 40 inches; strong brown clay loam

Substratum:
40 to 50 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Pirum soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 22 to 50 inches (hard)

Shrink-swell potential: low

Included in mapping are small areas of Bismarck, Carnasaw, and Sherless soils. Also included are small areas of soils that have slopes of more than 15 percent.

In most areas, the soils of this complex are used as woodland. In a few areas, they are used as native pasture.

These soils are not suited to cultivated crops, and they are severely limited for use as pasture. Surface stones and rock outcrop severely limit the use of farm equipment.

The potential of Pirum soil for production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, southern red oak, post oak, and hickory are suitable trees. With proper management, Pirum soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine, and Clebit soil has the capability of producing 45 to 50 cubic feet. These soils have severe limitations to use of equipment because of surface boulders, stones, and rock outcrops (fig. 5). The rooting depth of Clebit soil is restricted. Seedling mortality is severe on Clebit soil and moderate on Pirum soil.

The soils in this complex are poorly suited to most urban uses. Steepness of slope is a moderate limitation for dwellings, local roads and streets, and septic tank absorption fields, and a severe limitation for small commercial buildings. Designing the structure to conform to the natural slope or shaping and leveling the site can minimize this limitation. Surface stones are a moderate limitation to most urban uses. Depth to bedrock is a severe limitation to the use of Clebit soil and a moderate limitation to the use of Pirum soil as sites for dwellings, small commercial buildings, and local roads and streets. The depth to bedrock limitation for dwellings and small commercial buildings can be avoided by building above the bedrock and landscaping with additional fill or by building in areas of deeper soils within the map unit. Depth to bedrock limitations for septic tank absorption fields are difficult to overcome, and a specially designed system generally is required. Large stones may have to be removed.

Clebit and Pirum soils are in capability subclass VIIs. Rock outcrop is in capability subclass VIIIs. Clebit soil is in woodland suitability group 3X9, and Pirum soil is in woodland suitability group 8X9. Rock outcrop is not assigned to a woodland suitability group.

25—Leadvale silt loam, 1 to 3 percent slopes. This soil is deep, nearly level, and moderately well drained. It is on stream terraces where flooding does not typically occur. The areas of this soil range from 10 to 100 acres. The slopes generally are convex.

The typical sequence, depth, and composition of the layers of this Leadvale soil are as follows:

Surface layer:
0 to 2 inches; dark brown silt loam

Subsurface layer:
2 to 6 inches; yellowish brown silt loam

Subsoil:
6 to 20 inches; yellowish brown silt loam
20 to 29 inches; yellowish brown silty clay loam

Figure 5.—Boulders, stones, and Rock outcrop severely limit the use of equipment for managing or harvesting timber on Clebit-Pirum-Rock outcrop complex, 3 to 15 percent slopes.

29 to 48 inches; mottled yellowish brown, light brownish gray, and strong brown silty clay loam
48 to 60 inches; mottled light brownish gray, yellowish brown, and yellowish red silty clay loam

Substratum:
60 to 72 inches; partly weathered shale

Important soil properties of this Leadvale soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: very strongly acid or strongly acid

Surface runoff: medium

High water table: perched at a depth of 2 to 3 feet from December to May

Depth to bedrock: 48 to 60 inches or more

Included with this soil in mapping are small areas of Avilla, Ceda, and Mazarn soils. Also included are small areas of soils that have slopes of more than 3 percent.

This Leadvale soil is mainly used as pasture.

This soil is well suited to use as pasture. Bermudagrass, bahiagrass, tall fescue, and sericea lespedeza are adapted pasture plants. Appropriate management practices are proper stocking, controlled grazing, maintaining the fertility level, and controlling brush and weeds.

This soil is well suited to cultivated crops although the hazard of erosion is moderate. Soybeans and small grains are adapted crops. Conservation tillage, contour farming, and cover crops reduce runoff and help control erosion.

The potential of this soil for commercial production of wood products is moderately high. Loblolly pine, shortleaf pine, and southern red oak are suitable trees. With proper management, this soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine. This soil has no significant limitations for woodland management.

This soil is moderately suited to most urban uses. Slow permeability and wetness are severe limitations for septic tank absorption fields. These limitations can generally be alleviated by special design or enlargement of the absorption field. Wetness is a moderate limitation for dwellings and small commercial buildings. Landscaping to provide surface drainage and to divert runoff from structures helps to overcome the wetness limitation. Low strength and wetness are moderate limitations for local roads and streets. Suitable subbase material and adequate drainage help prevent damage to roads and streets.

This soil is in capability subclass IIe and in woodland suitability group 8A7.

26—Magnet loam, 15 to 40 percent slopes. This soil is moderately deep, moderately steep to steep, and well drained. It is on ridgetops and on side slopes of a ring dike complex in the county. The areas of this soil range from 10 to 150 acres.

The typical sequence, depth, and composition of the layers of this Magnet soil are as follows:

Surface layer:
0 to 6 inches; dark reddish brown loam

Subsoil:
6 to 30 inches; red clay loam

Substratum:
30 to 72 inches; soft, multicolored, syenitic saprolite with red clay in seams

Important properties of this Magnet soil:

Permeability: moderately slow

Available water capacity: moderate

Soil reaction: slightly acid to strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 50 inches (soft)

Included with this soil in mapping are small areas of Carnasaw soil that are in positions on the landscape similar to those of Magnet soil. Also included are a few small areas of soils that have a gravelly or cobbly surface layer.

This Magnet soil is mainly used as woodland.

This soil is poorly suited to use as pasture because of moderately steep to steep slopes. Bermudagrass, white clover, sericea lespedeza, and annual lespedeza are adapted pasture plants.

This soil is not suited to cultivated crops. Steep slopes severely limit the use of farm machinery, and the hazard of erosion is very severe.

The potential of this soil for commercial production of wood products is moderately high. Loblolly pine, shortleaf pine, and southern red oak are adapted trees. With proper management, this soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine. Equipment use limitations are moderate because of steep slopes. The hazard of erosion is a concern in management. Seedling mortality is moderate.

This soil is poorly suited to most urban uses. High shrink-swell potential and steepness of slope are severe limitations for dwellings, small commercial buildings, and local roads and streets. Wider footings, extra reinforcement, and excavating and backfilling with sand help to alleviate the limitations caused by the high shrink-swell potential. Designing the structure to conform to the natural slope or shaping and leveling the site can overcome or minimize the slope limitation. Low strength is also a severe limitation for local roads and streets. Excavating and backfilling with suitable subbase material can help to prevent damage caused by low strength and the high shrink swell potential. Slow permeability, slope, and depth to bedrock are severe limitations for septic tank absorption fields. These limitations are difficult to overcome and generally require a specially designed system.

This soil is in capability subclass VIIe and in woodland suitability group 8R8.

27—Mazarn silt loam, occasionally flooded. This soil is moderately deep, level to nearly level, and somewhat poorly drained. It is on low terraces. Flooding is infrequent, generally for brief periods from December to May. The areas of this soil range from about 5 to 200 acres. Slopes range from 0 to 2 percent.

The typical sequence, depth, and composition of the layers of this Mazarn soil are as follows:

Surface Layer:
0 to 4 inches; yellowish brown silt loam

Subsoil:
4 to 14 inches; light yellowish brown mottled silt loam
14 to 30 inches, brownish yellow mottled silt loam
30 to 36 inches, light brownish gray mottled silty clay loam

Substratum:
36 to 40 inches; gray, weathered shale, tilted about 20 degrees from horizontal

Important properties of this Mazarn soil:

Permeability: moderately slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: slow

High water table: perched at a depth of 1 foot to 2 feet from December to May

Depth to bedrock: 20 to 40 inches (soft)

Included with this soil in mapping are small areas of Bonnerdale, Ceda, Leadvale, and Spadra soils. Also included are a few areas of soils that are subject to frequent flooding, and areas of soils that have higher clay content in the subsoil.

This Mazarn soil is mainly used as pasture.

This soil is moderately suited to use as pasture. Bermudagrass, bahiagrass, and tall fescue are adapted pasture plants. Wetness and the hazard of occasional flooding are moderate limitations. Appropriate management practices include deferred grazing, rotation grazing, controlling weeds and brush, and proper stocking.

This soil is moderately suited to cultivated crops. Soybeans, grain sorghum, and corn are adapted crops. Wetness and the hazard of occasional flooding are limitations to crop production. Adequate surface drainage can help to prevent crop damage and can minimize delays in farming operations.

The potential of this soil for commercial production of wood products is moderately high. Loblolly pine, shortleaf pine, white oak, and sweetgum are suitable trees. With proper management, this soil has the capability of producing 95 to 105 cubic feet per acre per year of shortleaf pine. Moderate equipment use limitations and moderate seedling mortality, caused by wetness and flooding, are concerns in managing this soil as woodland. Equipment use should be limited to dry periods. Seedlings require special care during planting.

This soil is poorly suited to most urban uses. The hazard of occasional flooding, depth to bedrock, and wetness are limitations for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. These limitations generally are difficult or impractical to overcome. Areas of included soils or areas of soils in other map units are better suited to most urban uses.

This Mazarn soil is in capability subclass IIIw and in woodland suitability group 7W8.

28—Pirum-Clebit-Carnasaw complex, 8 to 20 percent slopes. This complex consists of soils that are moderately sloping to moderately steep, well drained, and stony. Pirum soil is moderately deep, Clebit soil is shallow, and Carnasaw soil is deep. These soils are on the tops of mountains. Stones, cobbles, and gravel are on the surface. Stones are the most limiting feature. These soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 acres to more than 100 acres.

This complex is made up of about 40 percent Pirum soil, 30 percent Clebit soil, 15 percent Carnasaw soil, and 15 percent other soils.

Typically, the Pirum soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Pirum soil are as follows:

Surface layer:
0 to 4 inches; dark brown stony loam

Subsurface layer:
4 to 10 inches; light yellowish brown loam

Subsoil:
10 to 25 inches; yellowish brown loam
25 to 40 inches; strong brown clay loam

Substratum:
40 to 50 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Pirum soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 22 to 50 inches (hard)

Shrink-swell potential: low

Typically, the Clebit soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown stony loam

Subsoil:
6 to 12 inches; dark yellowish brown stony loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Shrink-swell potential: low

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown stony loam

Subsurface layer:
2 to 5 inches; yellowish brown stony loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 32 inches; red and yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured, soft, partly weathered shale, tilted about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Included in mapping are soils similar to Carnasaw soil except they are deeper than 60 inches to bedrock and areas of soils that are less than 40 inches to bedrock. Also included are small areas of Bismarck soils.

In most areas, the soils in this complex are used as woodland. In a few areas, they are used as native pasture.

The soils in this complex are not suited to cultivated crops, and they are severely limited to use as pasture. Surface stones severely limit the use of farm equipment, and the hazard of erosion is very severe.

The potential of Carnasaw and Pirum soils for commercial production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, southern red oak, post oak, and hickory are suitable trees. With proper management, Pirum and Carnasaw soils have the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine, and Clebit soil has the capability of producing 45 to 50 cubic feet. Equipment use limitations are moderate to severe because of surface stones. The restricted rooting depth and seedling mortality are concerns in managing Clebit soil.

The soils in this complex are poorly suited to most urban uses. Steepness of slope is a moderate limitation to the use of these soils as sites for dwellings, local roads and streets, and septic tank absorption fields, and a severe limitation for small commercial buildings. This limitation can be minimized by designing the structure to conform to the natural slope or by shaping and leveling the site. The high shrink-swell potential of Carnasaw soil is a severe limitation for dwellings, small commercial buildings, and local roads and streets. The slow permeability of this soil is a severe limitation for septic tank absorption fields, and low strength is a severe limitation for local roads and streets. Wider footings, extra reinforcement, and excavating and backfilling with sand help to minimize the effects of shrinking and swelling. Providing suitable subgrade or base material for roads and streets helps to prevent damage caused by low strength. Depth to bedrock is a severe limitation to the use of Clebit and Pirum soils as sites for septic tank absorption fields. Depth to bedrock is also a severe limitation to the use of Clebit soil as sites for dwellings, small commercial buildings, and local roads and streets. This limitation requires special designs for construction or for installation of sanitary facilities and can add additional cost. The depth to bedrock limitation can be avoided by building above the bedrock and landscaping with additional fill or by building in areas of deeper soils within the map unit. The depth to bedrock and slow permeability limitations for septic tank absorption fields are difficult to overcome and generally require a specially designed system.

The soils in this complex are in capability subclass VIIs. Carnasaw and Pirum soils are in woodland suitability group 8X8, and Clebit soil is in woodland suitability group 3X9.

29—Pirum-Clebit-Carnasaw complex, 20 to 40 percent slopes. This complex consists of soils that are steep and well drained. Pirum soil is moderately deep, Clebit soil is shallow, and Carnasaw soil is deep. These soils are stony, and they are on the sides of mountains.

Stones, cobbles, and gravel are on the surface. Stones are the most limiting feature. These soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 80 to more than 500 acres.

This complex is made up of about 40 percent Pirum soil, 25 percent Clebit soil, 20 percent Carnasaw soil, and 15 percent other soils.

Typically, the Pirum soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Pirum soil are as follows:

Surface layer:
0 to 4 inches; dark brown stony loam

Subsurface layer:
4 to 10 inches; light yellowish brown loam

Subsoil:
10 to 25 inches; yellowish brown loam
25 to 40 inches; strong brown clay loam

Substratum:
40 to 50 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Pirum soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 22 to 50 inches (hard)

Shrink-swell potential: low

Typically, the Clebit soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown stony loam

Subsoil:
6 to 12 inches; dark yellowish brown stony loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Shrink-swell potential: low

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown stony loam

Subsurface layer:
2 to 5 inches; yellowish brown stony loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 32 inches; red and yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured, soft, partly weathered shale, tilted about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Included in mapping are soils similar to Carnasaw soil except they are deeper than 60 inches to bedrock and areas of soils that are less than 40 inches to bedrock. Also included are small areas of Bismarck soils, areas of soils that have boulders on the surface, and areas of rock outcrop.

In most areas, these soils are used as woodland.

The soils in this complex are not suited to cultivated crops and are severely limited for use as pasture. Slope and surface stones severely limit the use of farm equipment, and the hazard of erosion is very severe.

The potential of Carnasaw and Pirum soils for commercial production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, southern red oak, post oak, and hickory are suitable trees. With proper management, Pirum and Carnasaw soils have the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine, and Clebit soil has the capability of producing 45 to 50 cubic feet. Steep slopes and surface stones are moderate to severe limitations to the use of equipment. Erosion is a concern because of steep slopes. The restricted rooting depth and severe seedling mortality are concerns in managing Clebit soil as woodland.

The soils in this complex are poorly suited to most urban uses. Steepness of slope is a severe limitation for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. In addition, the high shrink-swell potential of Carnasaw soil is a severe limitation for dwellings, small commercial buildings, and local roads and streets. The slow permeability of this soil is a severe limitation for septic tank absorption fields, and low strength is a severe limitation for local roads and streets. Depth to bedrock is a severe limitation to the use of Clebit and Pirum soils as sites for septic tank absorption fields. These limitations are difficult to overcome and require special designs for construction or for installation of sanitary facilities.

These soils are in capability subclass VIIs. Carnasaw and Pirum soils are in woodland suitability group 8X8, and Clebit soil is in woodland suitability group 3X9.

30—Pirum-Clebit-Carnasaw complex, 40 to 60 percent slopes. This complex consists of soils that are very steep and well drained. Pirum soil is moderately deep, Clebit soil is shallow, and Carnasaw soil is deep. These soils are stony, and they are on the sides of mountains. Stones, cobbles, and gravel are on the surface. Stones are the most limiting feature. These soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 80 to more than 500 acres.

This complex is made up of about 50 percent Pirum soil, 20 percent Clebit soil, 15 percent Carnasaw soil, and 15 percent other soils.

Typically, the Pirum soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Pirum soil are as follows:

Surface layer:
0 to 4 inches; dark brown stony loam

Subsurface layer:
4 to 10 inches; light yellowish brown loam

Subsoil:
10 to 25 inches; yellowish brown loam
25 to 40 inches; strong brown clay loam

Substratum:
40 to 50 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal

Important properties of the Pirum soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 22 to 50 inches (hard)

Shrink-swell potential: low

Typically, the Clebit soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown stony loam

Subsoil:
6 to 12 inches; dark yellowish brown stony loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Shrink-swell potential: low

Typically, the Carnasaw soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Carnasaw soil are as follows:

Surface layer:
0 to 2 inches; very dark grayish brown stony loam

Subsurface layer:
2 to 5 inches; yellowish brown stony loam

Subsoil:
5 to 11 inches; strong brown silty clay loam
11 to 32 inches; red and yellowish red silty clay
32 to 42 inches; strong brown channery silty clay

Substratum:
42 to 50 inches; fractured, soft, partly weathered shale, tilted about 30 degrees from horizontal

Important properties of the Carnasaw soil:

Permeability: slow

Available water capacity: moderate

Soil reaction: strongly acid or very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 40 to 60 inches (soft)

Shrink-swell potential: high

Included in mapping are small areas of Bismarck soils, areas of soils that have boulders on the surface, areas of rock outcrop, and areas of soils similar to Carnasaw soil except they are deeper than 60 inches to bedrock. Also included are areas of soils that are less than 40 inches to bedrock.

In most areas, the soils in this complex are used as woodland.

The soils in this complex are not suited to cultivated crops or pasture. Slope and surface stones severely limit the use of farm equipment, and the hazard of erosion is very severe.

The potential of Carnasaw and Pirum soils for commercial production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, southern red oak, post oak, and hickory are suitable trees. With proper management, Pirum soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine, Clebit soil has the capability of producing 45 to 50 cubic feet, and Carnasaw soil has the capability of producing 95 to 105 cubic feet. Very steep slope is a limitation for use of equipment. The hazard of erosion is a concern because of slope. The restricted rooting depth, seedling mortality, and surface stones are additional concerns in managing these soils as woodland.

The soils in this complex are severely limited for most urban uses. Steepness of slope is a severe limitation for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. The high shrink-swell potential of Carnasaw soil is a severe limitation for dwellings, small commercial buildings, and local roads and streets. The slow permeability of this soil is a severe limitation for septic tank absorption fields, and low strength is a severe limitation for local roads and streets. Depth to bedrock is a severe limitation to the use of Clebit and Pirum soils as sites for septic tank absorption fields. These limitations are difficult to overcome and require special designs for construction or for installation of sanitary facilities.

These soils are in capability subclass VIIs. Pirum soil is in woodland suitability group 8R9, Clebit soil is in woodland suitability group 3R9, and Carnasaw soil is in woodland suitability group 7R9.

31—Pits-Udorthents complex. This complex consists of irregularly shaped pits and mine spoil material in areas that have been surface mined. The areas are 5 to 300 acres.

Pits make up about 50 percent of the complex, Udorthents make up about 40 percent, and included soils make up about 10 percent.

Pits generally are 10 to 150 feet deep and have vertical or nearly vertical walls. The floor and walls of a pit are mainly rock and sustain very little vegetation.

Udorthents are uneven piles of material consisting mainly of rock fragments and soil material. The piles are 10 to 100 feet high and sustain very little vegetation without major reclamation. Slopes range from 15 to 40 percent.

Included with this complex in mapping are areas of Bigfork and Magnet soils.

This complex is not suited to agricultural or urban uses without major reclamation.

This complex is not assigned to a capability unit or to a woodland suitability group.

32—Sherless-Clebit complex, 3 to 8 percent slopes. This complex consists of soils that are gently sloping and well drained. Sherless soil is moderately deep, and Clebit soil is shallow. These soils are gravelly and very gravelly, and they are on sides and tops of hills. The soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 200 acres.

This complex is made up of about 70 percent Sherless soil, 15 percent Clebit soil, and 15 percent other soils.

The typical sequence, depth, and composition of the layers of the Sherless soil are as follows:

Surface layer:
0 to 5 inches; dark brown gravelly fine sandy loam

Subsurface layer:
5 to 11 inches; light yellowish brown gravelly fine sandy loam

Subsoil:
11 to 26 inches; yellowish red clay loam
26 to 39 inches; yellowish red gravelly sandy clay loam

Substratum:
39 to 42 inches; red, brown, and gray, fractured, soft, weathered sandstone

Important properties of the Sherless soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: very strongly acid or strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet -

Depth tk bedrock: 20 tk 40 inches (soft)

The typical sequence, depth, and composition of the hayers of the Clebit soil are as follows:-

Surface layer:-
0 to 6 inches; very dark grayish brown very gravelly fine sandy loam

Subsoil:
6 to 12 inches; dark yellowish brown very gravelly loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: very strongly acid or strongly acid

Surface runoff: medium

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Included in mapping are small areas of Carnasaw and Pirum soils. Also included are small areas of soils that have cobbles on the surface and soils similar to Sherless soil except they are 10 to 20 inches deep to soft sandstone.

In most areas, these soils are used as pasture or woodland.

The soils in this complex are well suited or moderately suited to use as pasture and are poorly suited to cultivated crops. Clebit soil is droughty and it has very low available water capacity because of the shallow depth. In addition, the hazard of erosion is severe. Bahiagrass, bermudagrass, fescue, and native grasses generally are better adapted pasture plants.

The potential of Sherless soil for the commercial production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, white oak, and southern red oak are suitable trees. With proper management, Sherless soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine, and Clebit soil has the capability of producing 45 to 50 cubic feet. Severe seedling mortality, caused by the very low available water capacity and shallow rooting depth, is a concern in managing Clebit soil as woodland.

The soils in this complex are moderately suited to poorly suited to most urban uses. Steepness of slope is a moderate limitation to the use of these soils as sites for small commercial buildings. This limitation can be minimized by designing structures to conform to the natural slope or by shaping and leveling the site. Depth to bedrock is a severe limitation to the use of Sherless and Clebit soils as sites for septic tank absorption fields, and a severe limitation to the use of Clebit soil as sites for dwellings, small commercial buildings, and local roads and streets. This limitation can be avoided by building above bedrock and landscaping with additional fill or by building in areas of deeper soils within the map unit. Depth to bedrock limitations for septic tank absorption fields are difficult to overcome, and a specially designed system generally is required.

These soils are in capability subclass IVe. Sherless soil is in woodland suitability group 8A7, and Clebit soil is in woodland suitability group 3D9.

33—Sherless-Clebit complex, 8 to 12 percent slopes. This complex consists of soils that are moderately sloping, well drained, gravelly and very gravelly. Sherless soil is moderately deep, and Clebit soil is shallow. These soils are on sides and tops of hills. They were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 200 acres.

This complex consists of about 60 percent Sherless soil, 25 percent Clebit soil, and 15 percent other soils.

The typical sequence, depth, and composition of the layers of the Sherless soil are as follows:

Surface layer:
0 to 5 inches; dark brown gravelly fine sandy loam

Subsurface layer:
5 to 11 inches; light yellowish brown gravelly fine sandy loam

Subsoil:
11 to 26 inches; yellowish red clay loam
26 to 39 inches; yellowish red gravelly sandy clay loam

Substratum:
39 to 42 inches; red, brown, and gray, fractured, soft, weathered sandstone

Important properties of the Sherless soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: very strongly acid or strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (soft)

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown very gravelly fine sandy loam

Subsoil:
6 to 12 inches; dark yellowish brown very gravelly loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: very strongly acid or strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Included in mapping are small areas of Carnasaw and Pirum soils and small areas of soils that have cobbles on the surface. Also included are soils similar to Sherless soil except they are 10 to 20 inches deep to soft sandstone.

The soils in this complex are poorly suited to use as pasture and are severely limited to use as cropland. The hazard of erosion is very severe. Clebit soil is droughty and it has a very low available water capacity because of the shallow depth. Fescue and native grasses generally are better adapted pasture plants.

The potential of Sherless soil for the commercial production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, white oak, and southern red oak are suitable trees. With proper management, Sherless soil has the capacity of producing 108 to 120 cubic feet per acre per year of shortleaf pine, and Clebit soil has the capability of producing 45 to 50 cubic feet. Severe seedling mortality, caused by the very low available water capacity and shallow rooting depth, is a concern in managing Clebit soil as woodland.

The soils in this complex are moderately suited to poorly suited to most urban uses. Steepness of slope is a severe limitation to the use of these soils as sites for small commercial buildings, and a moderate limitation for dwellings and local roads and streets. This limitation can be minimized by designing structures to conform to the natural slope or by shaping and leveling the site. Depth to bedrock is a severe limitation for the use of Sherless and Clebit soils as sites for septic tank absorption fields. In addition, depth to bedrock is a severe limitation to the use of Clebit soil as sites for dwellings, small commercial buildings, and local roads and streets. This limitation can be avoided by building above bedrock and landscaping with additional fill or by building in areas of deeper soils within the map unit. Depth to bedrock limitations for septic tank absorption fields are difficult to overcome, and a specially designed system generally is required.

These soils are in capability subclass VIe. Sherless soil is in woodland suitability group 8A7, and Clebit soil is in woodland suitability group 3D9.

34—Sherless-Clebit complex, 12 to 30 percent slopes. This complex consists of soils that are moderately steep to steep, well drained, gravelly and very gravelly. Sherless soil is moderately deep, and Clebit soil is shallow. These soils are on sides and tops of hills. They were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 200 acres.

This complex is made up of about 60 percent Sherless soil, 25 percent Clebit soil, and 15 percent other soils.

The typical sequence, depth, and composition of the layers of the Sherless soil are as follows:

Surface layer:
0 to 5 inches; dark brown gravelly fine sandy loam

Subsurface layer:
5 to 11 inches; light yellowish brown gravelly fine sandy loam

Subsoil:
11 to 26 inches; yellowish red clay loam
26 to 39 inches; yellowish red gravelly sandy clay loam

Substratum:
39 to 42 inches; red, brown, and gray, weathered, soft, fractured sandstone

Important properties of the Sherless soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: very strongly acid or strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (soft)

The typical sequence, depth, and composition of the layers of the Clebit soil are as follows:

Surface layer:
0 to 6 inches; very dark grayish brown very gravelly fine sandy loam

Subsoil:
6 to 12 inches; dark yellowish brown very gravelly loam

Substratum:
12 to 24 inches; fractured, hard sandstone bedrock, tilted about 35 degrees from horizontal

Important properties of the Clebit soil:

Permeability: moderately rapid

Available water capacity: very low

Soil reaction: very strongly acid or strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 10 to 20 inches (hard)

Included in mapping are small areas of Carnasaw and Pirum soils and small areas of soils that have cobbles and stones on the surface. Also included are soils that are similar to Sherless soil except they are 10 to 20 inches deep to soft sandstone.

In most areas, the soils in this complex are used as woodland or native pasture.

The soils in this complex are poorly suited to use as pasture and are not suited to cultivated crops. Clebit soil is droughty and it has very low available water capacity because of the shallow depth. In addition, the hazard of erosion is very severe. Fescue and native grasses generally are better adapted pasture plants.

The potential of Sherless soil for the commercial production of wood products is moderately high, and the potential of Clebit soil is low. Shortleaf pine, loblolly pine, white oak, and southern red oak are suitable trees. With proper management, Sherless soil has the capability of producing 108 to 120 cubic feet per acre per year of shortleaf pine, and Clebit soil has the capability of producing 45 to 50 cubic feet. Steepness of slope is a moderate limitation to use of equipment on these soils and the hazard of erosion is a concern in managing these soils as woodland. Seedling mortality is severe on the Clebit soil because of the very low available water capacity and shallow rooting depth.

The soils in this complex are poorly suited to most urban uses. Depth to bedrock and steepness of slope are severe limitations for septic tank absorption fields, and slope is also a severe limitation for dwellings, small commercial buildings, and local streets and roads. This limitation can be minimized by designing the structure to conform to the natural slope or by shaping and grading the site. Depth to bedrock is a severe limitation to the use of Clebit soil as sites for dwellings, small commercial buildings, and local roads and streets. The depth to bedrock limitation for construction can be avoided by building above bedrock and landscaping with additional fill or by building in areas of deeper soils within the map unit. The depth to bedrock and slope limitations for septic tank absorption fields are difficult to overcome, and a specially designed system generally is required.

These soils are in capability subclass VIIe. Sherless soil is in woodland suitability group 8R8, and Clebit soil is in woodland suitability group 3D9.

35—Spadra loam, occasionally flooded. This soil is deep, level to nearly level, and well drained. It is on terraces. Flooding is infrequent, generally for brief periods from December to April. The areas of this soil range from about 10 to 100 acres or more. Slopes range from 0 to 2 percent.

The typical sequence, depth, and composition of the layers of this Spadra soil are as follows:

Surface layer:
0 to 3 inches; dark brown loam

Subsoil:
3 to 13 inches; yellowish red loam
13 to 39 inches; yellowish red clay loam
39 to 48 inches; strong brown clay loam
48 to 60 inches; strong brown loam

Substratum:
60 to 72 inches; strong brown loam

Important properties of this Spadra soil:

Permeability: moderate

Available water capacity: high

Soil reaction: strongly acid or very strongly acid

Surface runoff: slow

High water table: none within a depth of 6 feet

Depth to bedrock: more than 72 inches

Included with this soil in mapping are small areas of Avilla, Bonnerdale, Ceda, Leadvale, and Mazarn soils. Also included are a few areas of soils that are subject to frequent flooding.

This Spadra soil is mainly used as pasture.

This soil is well suited to use as pasture (fig. 6). Common bermudagrass, tall fescue, bahiagrass, white clover, sericea lespedeza, and annual lespedeza are adapted pasture plants. The hazard of occasional flooding is moderate. Appropriate management practices include deferred grazing, rotation grazing, controlling weeds and brush, and proper stocking.

This soil is well suited to cultivated crops. Soybeans, grain sorghum, and corn are adapted crops. The hazard of occasional flooding is the main concern for crop production.

The potential of this soil for commercial production of wood products is high. Loblolly pine, shortleaf pine, and southern red oak are suitable trees. With proper management, this soil has the capability of producing 124 to 134 cubic feet per acre per year of shortleaf pine. This soil has no significant limitations for woodland management.

This soil is poorly suited to most urban uses. The hazard of occasional flooding severely limits the use of this soil as sites for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. This hazard generally is difficult or impractical to overcome without major flood control. Sites above known flood levels should be selected for most urban uses.

This Spadra soil is in capability subclass IIw and in woodland suitability group 9A7.

36—Udorthents. These soils are shallow to deep, nearly level to moderately sloping, and well drained. This material remains from areas that were excavated and stripped of soil material that was used as fill. The material has been backfilled and shaped, but some areas contain piles of spoil. The individual areas range from 5 to 600 acres. The slope ranges from 1 to 12 percent.

The typical sequence, depth, and composition of this Udorthents soil are variable.

The soil material ranges from gravelly loam to very cobbly clay loam that has no definite arrangement into textural layers because of the mixing during excavating and backfilling operations. The content of coarse fragments ranges from 15 to 90 percent.

Important properties of Udorthents soil:

Permeability: moderate to rapid

Available water capacity: low to very low, depending upon the content of coarse fragments

Soil reaction: strongly acid to extremely acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Included in mapping are a few small areas of Bigfork and Carnasaw soils. Also included are small areas of exposed bedrock.

In most areas, this Udorthents soil is used as woodland.

The smoothed areas are moderately suited to use as pasture, but the piles of spoil are poorly suited. Bermudagrass, tall fescue, sericea lespedeza, and native grasses are adapted pasture plants. This soil is not suited to cultivated crops.

The potential of this soil for the commercial production of wood products is low. Loblolly pine, shortleaf pine, and southern red oak are suitable trees. Moderate seedling mortality and droughtiness are concerns for woodland use and management.

Udorthents are poorly suited to most urban uses. This soil has moderate to severe limitations for dwellings, small commercial buildings, septic tank absorption fields, and local roads and streets.

Because these soils are variable, they are not assigned to a capability subclass or to a woodland suitability group.

37—Yanush very gravelly silt loam, 3 to 12 percent slopes. This soil is deep, gently sloping to moderately

Figure 6.—Spadra loam, occasionally flooded, is well suited to fescue and bermudagrass hay and to use as pasture.

sloping, and well drained. It is on foot slopes of chert hills. The areas of this soil range from 10 to 100 acres. Slopes generally are convex.

The typical sequence, depth, and composition of the layers of this Yanush soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown very gravelly silt loam

Subsurface layer:
3 to 5 inches; brown very gravelly silt loam

Subsoil:
5 to 44 inches; strong brown very gravelly silty clay loam

44 to 72 inches; strong brown extremely gravelly silty clay loam

Important properties of this Yanush soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: medium acid to very strongly acid

Surface runoff: medium to rapid

High water table: none within a depth of 6 feet

Depth to bedrock: more than 60 inches

Included with this soil in mapping are small areas of Avant, Big Fork, and Carnasaw soils. Also included are areas of soils that have slopes of less than 3 percent and soils that have slopes of more than 12 percent.

This Yanush soil is mainly used as woodland or native pasture.

This soil is moderately suited to poorly suited to use as pasture. Bahiagrass, tall fescue, bermudagrass, and native grasses are adapted pasture plants. Appropriate management practices include seedbed preparation, proper stocking, controlled grazing, and brush and weed control.

This soil is poorly suited to cultivated crops. Fragments on the surface make seedbed preparation difficult. In addition, the hazard of erosion is severe.

The potential of this soil for the commercial production of wood products is moderately high. Loblolly pine, shortleaf pine, and southern red oak are suitable trees. With proper management, this soil has the capability of producing 95 to 105 cubic feet per acre per year of shortleaf pine. Seedling mortality is moderate.

This soil is moderately suited to most urban uses. Steepness of slope is a moderate limitation for dwellings, local roads and streets, and septic tank absorption fields, and a severe limitation for small commercial buildings. Designing the structure to conform to the natural slope or shaping and leveling the site can overcome or minimize the slope limitation. Moderate permeability is a moderate limitation for septic tank absorption fields. Enlarging the absorption field can help to minimize this limitation. The content of coarse fragments is also a moderate limitation for most urban uses.

This Yanush soil is in capability subclass IVe and in woodland suitability group 7F8.

38—Yanush-Avant complex, 20 to 40 percent slopes. This complex consists of soils that are steep and well drained. Yanush soil is deep, and Avant soil is moderately deep. These soils are very gravelly, and they are on sides and tops of hills and ridges. Gravel and a few cobbles are on the surface. Gravel is the most limiting feature. These soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 200 acres or more.

This complex is made up of about 50 percent Yanush soil, 35 percent Avant soil, and 15 percent other soils.

Typically, the Yanush soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Yanush soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown very gravelly silt loam

Subsurface layer:
3 to 5 inches; brown very gravelly silt loam

Subsoil:
5 to 44 inches; strong brown very gravelly silty clay loam
44 to 72 inches; strong brown extremely gravelly silty clay loam

Important properties of the Yanush soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: medium acid to very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: more than 60 inches

Typically, the Avant soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Avant soil are as follows:

Surface layer:
0 to 3 inches; dark brown very gravelly silt loam

Subsurface layer:
3 to 7 inches; yellowish brown very gravelly silt loam

Subsoil:
7 to 17 inches; yellowish brown very gravelly silt loam
17 to 36 inches; strong brown very cobbly silty clay loam

Substratum:
36 to 42 inches; highly fractured, tilted and folded, chert bedrock that has thin strata of mottled stratified clay, clay loam, and very fine sandy loam

Important properties of the Avant soil:

Permeability: moderate

Available water capacity: low

Soil reaction: medium acid to very strongly acid

Surface runoff: rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (rippable)

Included in mapping are small areas of Bigfork, Carnasaw, and Bismarck soils. Also included are soils similar to Avant soil except they are 40 to 60 inches to bedrock.

In most areas, the soils in this complex are used as woodland. In a few areas, they are used as native pasture or for urban development.

These soils are not suited to cultivated crops and are severely limited to use as pasture. Where pasture is established, plants include tall fescue and native grasses. These soils can be used as native grass pasture if brush can be controlled; however, controlled grazing and fire protection are needed to maintain soil cover and to prevent excessive erosion. Slope and surface gravel severely restrict the use of farm equipment, and the hazard of erosion is very severe.

The potential of Yanush soil for commercial production of wood products is moderately high, and the potential of Avant soil is moderate. Shortleaf pine, loblolly pine, and southern red oak are suitable trees. With proper management, Yanush soil has the capability of producing 95 to 105 cubic feet per acre per year of shortleaf pine, and Avant soil has the capability of producing 80 to 90 cubic feet. Steepness of slope is a moderate limitation for use of equipment. The hazard of erosion is a concern because of steep slopes. The high content of coarse fragments in these soils reduces the available water capacity and causes moderate seedling mortality.

The soils in this complex are poorly suited to most urban uses. Steepness of slope is a severe limitation to use as sites for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. The depth to bedrock of Avant soil is also a severe limitation for septic tank absorption fields. These limitations are difficult to overcome and require special designs for construction or for installation of sanitary facilities.

These soils are in capability subclass VIIe. Yanush soil is in woodland suitability group 7R8. Avant soil is in woodland suitability group 6R8.

39—Yanush-Avant complex, 40 to 60 percent slopes. This complex consists of soils that are very steep and well drained. Yanush soil is deep, and Avant soil is moderately deep. These soils are very gravelly and are on sides of hills and ridges. Gravel and a few cobbles are on the surface. Gravel is the most limiting feature. These soils were mapped as a complex because they were too intermingled to map separately at the selected scale. Individual areas of this complex range from about 20 to 500 acres or more.

This complex is made up of about 50 percent Yanush soil, 35 percent Avant soil, and 15 percent other soils.

Typically, the Yanush soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Yanush soil are as follows:

Surface layer:
0 to 3 inches; dark grayish brown very gravelly silt loam

Subsurface layer:
3 to 5 inches; brown very gravelly silt loam

Subsoil:
5 to 44 inches; strong brown very gravelly silty clay loam
44 to 72 inches; strong brown extremely gravelly silty clay loam

Important properties of the Yanush soil:

Permeability: moderate

Available water capacity: moderate

Soil reaction: medium acid to very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: more than 60 inches

Typically, the Avant soil is covered by a thin layer of partly decomposed and decomposed leaves, needles, and twigs.

The typical sequence, depth, and composition of the layers of the Avant soil are as follows:

Surface layer:
0 to 3 inches; dark brown very gravelly silt loam

Subsurface layer:
3 to 7 inches; yellowish brown very gravelly silt loam

Subsoil:
7 to 17 inches; yellowish brown very gravelly silt loam
17 to 36 inches; strong brown very cobbly silty clay loam

Substratum:
36 to 42 inches; highly fractured, tilted and folded, chert bedrock that has thin strata of mottled, stratified clay, clay loam, and very fine sandy loam

Important properties of the Avant soil:

Permeability: moderate

Available water capacity: low

Soil reaction: medium acid to very strongly acid

Surface runoff: very rapid

High water table: none within a depth of 6 feet

Depth to bedrock: 20 to 40 inches (rippable)

Included in mapping are small areas of Bigfork, Carnasaw, and Bismarck soils. Also included are soils similar to Avant soil except they are 40 to 60 inches to bedrock.

In most areas, the soils of this complex are used as woodland.

These soils are not suited to cultivated crops or pasture. Very steep slopes severely restrict the use of farm equipment, and the hazard of erosion is very severe.

The potential of Yanush soil for commercial production of wood products is moderately high, and the potential of Avant soil is moderate. Shortleaf pine, loblolly pine, and southern red oak are suitable trees. With proper management, Yanush soil has the capability of producing 95 to 105 cubic feet per acre per year of shortleaf pine, and Avant soil has the capability of producing 80 to 90 cubic feet. Steepness of slope is a severe limitation to the use of equipment. The hazard of erosion is a concern because of very steep slopes. The high content of coarse fragments in these soils reduces the available water capacity and causes moderate seedling mortality.

The soils in this complex are severely limited for most urban uses. Steepness of slope is a severe limitation for dwellings, small commercial buildings, local roads and streets, and septic tank absorption fields. The depth to bedrock of Avant soil is a severe limitation for septic tank absorption fields. These limitations are difficult to overcome and require special designs for construction or for installation of sanitary facilities.

These soils are in capability subclass VIIe. Yanush soil is in woodland suitability group 7R9. Avant soil is in woodland suitability group 6R9.

Prime Farmland

In this section, prime farmland is defined and discussed, and the prime farmland soils in Garland County are listed.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the nation's short- and long-range needs for food and fiber. The acreage of high-quality farmland is limited, and the U.S. Department of Agriculture recognizes that government at local, state, and federal levels, as well as individuals, must encourage and facilitate the wise use of our nation's prime farmland.

Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils that are best suited to producing food, feed, forage, fiber, and oilseed crops. Such soils have properties that are favorable for the economic production of sustained high yields of crops. The soils need only to be treated and managed using acceptable farming methods. The moisture supply, of course, must be adequate, and the growing season has to be sufficiently long. Prime farmland soils produce the highest yields with minimal inputs of energy and economic resources. Farming these soils results in the least damage to the environment.

Prime farmland soils may presently be in use as cropland, pasture, or woodland, or they may be in other uses. They are used for producing food or fiber or are available for these uses. Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, sites for institutions or public buildings, small parks, golf courses, cemeteries, railroad yards, airports, sanitary landfills, sewage treatment plants, and water control structures. Public land is land not available for farming in national forests, national parks, military reservations, and state parks.

Prime farmland soils usually get an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The acidity or alkalinity level of the soils is acceptable. The soils have few or no rocks and are permeable to water and air. They are not excessively erodible or saturated with water for long periods and are not subject to frequent flooding during the growing season. The slope ranges mainly from 0 to 8 percent.

The following map units, or soils, make up prime farmland in Garland County. The location of each map unit is shown on the detailed soil maps at the back of this publication. The extent of each unit is given in table 4. The soil qualities that affect use and management are described in the section "Detailed Soil Map Units." This list does not constitute a recommendation for a particular land use.

Soils that have limitations, such as a high water table or flooding, may qualify as prime farmland if these limitations are overcome by such measures as drainage or flood control. In the following list, the measures needed to overcome the limitations of a map unit, if any, are shown in parentheses after the map unit name. Onsite evaluation is necessary to determine if the limitations have been overcome by the corrective measures.

2—Avilla silt loam, 1 to 3 percent slopes
3—Avilla silt loam, 3 to 8 percent slopes
15—Bonnerdale fine sandy loam, occasionally flooded (where drained)
25—Leadvale silt loam, 1 to 3 percent slopes
27—Mazarn silt loam, occasionally flooded (where drained)
35—Spadra loam, occasionally flooded

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern that is in harmony with nature.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Larry Farris, agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

Field crops were harvested on approximately 4,334 acres in Garland County in 1982, according to the Census of Agriculture. About 33,109 acres was used for all types of pasture. Of that acreage, about 11,464 acres was cropland that was used as pasture, about 9,532 acres was in other improved and unimproved pasture, and about 12,113 acres was in woodland pasture.

Most cleared land in the county is used for pasture and hay. The acreage of row crops is generally small. The areas of soils that are well suited to row crops are mainly on flood plains and terraces along streams in the county; however, the small size of these areas makes production of most row crops impractical. Some of the gently sloping to moderately sloping soils on uplands are moderately suited to drilled or sown crops, mainly oats, wheat, and grain sorghum.

Many soils in the upland area of the county are poorly suited or not suited to intensive use for crops because of surface stoniness, steepness of slope, shallow depth to bedrock, high content of coarse fragments within the soil, or a combination of these limitations.

Erosion control is needed on sloping soils. Contour cultivation, terraces, or grassed waterways, or combinations of these measures, can help control erosion. In addition, conservation tillage is needed on most soils so that residue from harvested crops is left on the surface as long as possible before planting. Tillage for weed control can be used if necessary, but it should be reduced by use of herbicides.

Annual cover crops or grasses and legumes should be grown regularly in the cropping system if erosion is a severe hazard or if the crops leave only small amounts of residue. Proper row arrangement and suitable surface drainage are needed for dependable growth in wet areas. A soil that is subject to frequent flooding, such as Ceda gravelly loam, is not suited to crops commonly grown in this county.

In general, the soils in Garland County are low in nitrogen, potassium, phosphorus, calcium, and organic matter. The kinds and amounts of fertilizer applied generally are based on soil tests, crops selected, capability of the soil to produce, expected yields, and past experience. Soil tests on most soils indicate that lime helps most crops and generally is necessary for satisfactory production of such crops as bermudagrass, tall fescue, white clover, red clover, vegetables, and other specialty crops.

Perennial grasses or mixtures of grasses and legumes are grown for pasture and hay. Mixtures generally consist of either a warm-season or a cool-season perennial grass and a suitable legume.

Common and hybrid bermudagrasses are the most commonly grown warm-season perennial grasses. These warm-season plants are propagated by sprigging, or by sprigging and seeding, in the case of common bermudagrass. Bermudagrass generally is sprigged because stands started by seeding are more susceptible to winter-kill. White clover is the most commonly grown legume. Tall fescue is the most commonly grown cool-season grass.

Under good pasture management, proper grazing is essential for the production of high quality forage, stand survival, and erosion control. Proper grazing helps plants maintain sufficient and generally vigorous top growth during the growing season. An appropriate management practice includes restricted grazing of tall fescue and other cool-season grasses during the hot, dry summer. Brush control is essential in many areas, and weed control generally is needed. Rotation grazing and renovation are also important management practices.

Pasture grasses respond well to nitrogen fertilizer. Grass and legume mixtures require phosphate, potash, and lime at rates based on soil test results.

Small acreages are in commercial and home orchards and home gardens. Although the acreage and cash income from these enterprises are small, they are important. Most farm families and many urban families can and freeze homegrown fruit and vegetables for home use.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for use as cropland. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major, and generally expensive, landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use. No class I soils are in Garland County.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode, but they have other limitations, impractical to remove, that limit their use. No class V soils are in Garland County.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w,* or *s,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless a close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); and *s* shows that the soil is limited mainly because it is shallow, droughty, or stony.

There are no subclasses in class I because the soils of this class have few limitations. The soils in class V are subject to little or no erosion, but they have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation. Class V contains only the subclasses indicated by *w* or *s*.

The capability classification of each map unit is given in the section "Detailed Soil Map Units."

Woodland Management and Productivity

Kelly M. Koonce, forester, Soil Conservation Service, helped prepare this section.

Forest land accounts for about 278,085 acres, or 66 percent of Garland County. About 117,370 acres is in public ownership; 132,279 acres is in industrial ownership, and 28,436 acres is privately owned.

The major forests in Garland County include the loblolly/shortleaf pine forest, consisting of about 110,020 acres; the oak/pine forest, consisting of about 162,055 acres; and the oak/hickory forest, consisting of about 6,010 acres. In these forests are 189,050 acres of sawlog stands, 56,637 acres of pole stands, and 32,398 acres of seedling and sapling stands.

Forest products contribute greatly to the local economy. Five small sawmills, three large sawmills, two pulpwood yards, and several other specialty wood-using industries are in the county. Products include lumber, crossties, roof trusses, wood turnings, custom cabinets, and hardwood furniture stock.

The main trees in Garland County are shortleaf pine, loblolly pine, white oak, sweetgum, blackgum, post oak, red oak, elm, and various hickories. Almost all of the soils within the county produce trees for profit, wildlife habitat, recreation, natural beauty, and the conservation of soil and water.

Soils vary in their ability to produce trees. Depth, fertility, texture, and the available water capacity influence tree growth. Elevation, aspect, and climate determine the kinds of trees that can grow on a site. Available water capacity and depth of the root zone are major influences of tree growth. Elevation and aspect are of particular importance in mountainous areas.

This soil survey can be used by woodland managers planning ways to increase the productivity of forest land. Some soils respond better to fertilization than others, and some are more susceptible to landslides and erosion after roads are built and timber is harvested. Some soils require special efforts to reforest. In the section "Detailed Soil Map Units," each map unit in the survey area suitable for producing timber presents information about productivity, limitations for harvesting timber, and management concerns for producing timber. Table 6 summarizes this forestry information and rates the soils for a number of factors to be considered in management. *Slight, moderate*, and *severe* are used to indicate the degree of the major soil limitations to be considered in forest management.

The first tree listed for each soil under the column "Common trees" is the indicator species for that soil. An indicator species is a tree that is common in the area and that is generally the most productive on a given soil.

Table 6 lists the *woodland suitability group* for each soil. The first part of the symbol, a number, indicates the potential productivity of a soil for the indicator species in cubic meters per hectare. The larger the number, the greater the potential productivity. Potential productivity is based on the site index and the point where mean annual increment is the greatest.

The second part of the symbol, a letter, indicates the major kind of soil limitation for use and management. The letter *R* indicates a soil that has a significant limitation because of steepness of slope. The letter *X* indicates that a soil has restrictions because of stones or rocks on the surface. The letter *W* indicates a soil in which excessive water, either seasonal or year-round, causes a significant limitation. The letter *D* indicates a soil that has a limitation because of restricted rooting depth, such as a shallow soil that is underlain by hard rock, hardpan, or other layers that restrict roots. The letter *F* indicates a soil that has a large amount of coarse fragments in the soil profile. The letter *A* indicates a soil that has no significant restrictions or limitations for forest use and management. If a soil has more than one limitation, the priority is as follows: R, X, W, D, and F.

The third element in the symbol, a numeral, indicates the kind of trees to which the soils in the group are adapted and also indicates the severity of the hazard or limitation. Only the hazard of erosion, equipment limitation, and seedling mortality are considered in making the following ratings. The numerals 7, 8, and 9 indicate slight, moderate, and severe limitations, respectively, and suitability for both needleleaf and broadleaf trees.

Ratings of the *erosion hazard* indicate the probability that damage may occur if site preparation activities or harvesting operations expose the soil. The risk is *slight* if no particular preventive measures are needed under ordinary conditions; *moderate* if erosion control measures are needed for particular silvicultural activities; and *severe* if special precautions are needed to control erosion for most silvicultural activities. Ratings of *moderate* or *severe* indicate the need for construction of higher standard roads, additional maintenance of roads, additional care in planning of harvesting and reforestation operations, or use of specialized equipment.

Ratings of *equipment limitation* indicate limits on the use of forest management equipment, year-round or seasonal, because of such soil characteristics as slope, wetness, stoniness, or susceptibility of the surface layer to compaction. As slope gradient and length increase, it becomes more difficult to use wheeled equipment. On the steeper slopes, tracked equipment must be used. On the steepest slopes, even tracked equipment cannot operate; more sophisticated systems are needed. The rating is *slight* if equipment use is restricted by soil wetness for less than 2 months and if special equipment is not needed. The rating is *moderate* if slopes are steep enough that wheeled equipment cannot be operated safely across the slope, if soil wetness restricts equipment use from 2 to 6 months per year, if stoniness restricts ground-based equipment, or if special equipment is needed to avoid or reduce soil compaction. The rating is *severe* if slopes are steep enough that tracked equipment cannot be operated safely across the slope, if soil wetness restricts equipment use for more than 6 months per year, if stoniness restricts ground-based equipment, or if special equipment is needed to avoid or reduce soil compaction. Ratings of *moderate* or *severe* indicate a need to choose the most suitable equipment and to carefully plan the timing of harvesting and other management operations.

Ratings of *seedling mortality* refer to the probability of death of naturally occurring or properly planted seedlings of good stock in periods of normal rainfall as influenced by kinds of soil or topographic features. *Seedling mortality* is caused primarily by too much water or too little water. The factors used in rating a soil for seedling mortality are texture of the surface layer, depth and duration of the water table, rock fragments in the surface layer, rooting depth, and the aspect of the slope. Mortality generally is greatest on soils that have a sandy or clayey surface layer. The risk is *slight* if, after site preparation, expected mortality is less than 25 percent; *moderate* if expected mortality is between 25 and 50 percent; and *severe* if expected mortality exceeds 50 percent. Ratings of *moderate* or *severe* indicate that it may be necessary to use containerized or larger than usual planting stock or to make special site preparations, such as bedding, furrowing, installing surface drainage, or providing artificial shade for seedings. Reinforcement planting is often needed if the risk is *moderate* or *severe*.

Ratings of *windthrow hazard* consider the likelihood of trees being uprooted by the wind. Restricted rooting depth is the main reason for windthrow. Rooting depth can be restricted by a high water table, fragipan, or bedrock, or by a combination of such factors as soil wetness, texture, structure, and depth. The risk is *slight* if strong winds cause trees to break but do not uproot them; *moderate* if strong winds cause an occasional tree to be blown over and many trees to break; and *severe* if moderate or strong winds commonly blow trees over. Ratings of *moderate* or *severe* indicate the need for care in thinning or possibly not thinning. Specialized equipment may be needed to avoid damage to shallow root systems in partial cutting operations. A plan for periodic salvage of windthrown trees and the maintenance of a road and trail system may be needed.

Ratings of *plant competition* indicate the likelihood of the growth or invasion of undesirable plants. *Plant competition* becomes more severe on the more productive soils, on poorly drained soils, and on soils having a restricted root zone that holds moisture. The risk is *slight* if competition from undesirable plants reduces adequate natural or artificial reforestation but does not necessitate intensive site preparation and maintenance. The risk is *moderate* if competition from undesirable plants reduces natural or artificial reforestation to the extent that intensive site preparation and maintenance are needed. The risk is *severe* if competition from undesirable plants prevents adequate natural or artificial reforestation unless the site is intensively prepared and maintained. A *moderate* or *severe* rating indicates the need for site preparation to ensure the development of an adequately stocked stand. Managers must plan site preparation measures to ensure reforestation without delays.

The potential productivity of *common trees* on a soil is expressed as a *site index*. Common trees are listed in the order of their observed general occurrence. Generally, only two or three tree species dominate.

The soils that are commonly used to produce timber have the yield predicted in cubic feet and cubic meters. The yield is predicted at the point where mean annual increment culminates. The productivity of the soils in this survey is mainly based on shortleaf pine but other trees are used where appropriate.

The *site index* is determined by taking height measurements and determining the age of selected trees within stands of a given species. This index is the average height, in feet, that the trees attain in a specified number of years. This index applies to fully stocked, even-aged, unmanaged stands. The procedure and technique for determining site index are given in the site index tables used for the Garland County soil survey *(3, 4, 5, 6, 7)*.

The *productivity class* represents an expected volume produced by the most important trees, expressed in cubic meters per hectare per year or cubic feet per acre per year. Cubic meters per hectare can be converted to cubic feet per acre by multiplying by 14.3. It can be converted to board feet by multiplying by a factor of about 71. For example, a productivity class of 8 means the soil can be expected to produce 114 cubic feet per acre per year at the point where mean annual increment culminates, or about 568 board feet per acre per year.

Recreation

In table 7, the soils of the survey area are rated according to the limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 7, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 7 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 10 and interpretations for dwellings without basements and for local roads and streets in table 9.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes, stones, or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Paul Brady, biologist, Soil Conservation Service, helped prepare this section.

Part of the Ouachita National Forest and part of the land owned by the Weyerhaeuser Company make up nearly half of Garland County. These areas include plantings of improved loblolly pine and improved shortleaf pine (in the National Forest), but these and many other areas in the county include extensive acreages of native shortleaf pine and hardwoods.

Major hardwoods are blackjack oak, southern red oak, chinkapin oak, post oak, hickory, elm, and sweetgum. White oak and black walnut are high-quality trees, but generally are low in number. Shortleaf pine, loblolly pine, and eastern redcedar are the native evergreens.

Common bermudagrass and tall fescue are the major pasture grasses. Hybrid bermudagrasses, bahiagrass, white clover, and annual lespedeza are in lesser amounts.

The plentiful forests, pastures, and fence rows provide much food and cover for white-tailed deer, wild turkey, squirrels, bobwhite quail, raccoons, coyotes, opossums, foxes, rabbits, owls, hawks, numerous nongame birds, small mammals, reptiles, and other wildlife.

Lowland habitats along streams, lakes, and ponds support a variety of furbearers, including beaver, muskrat, mink, raccoon, gray fox, striped skunk, and coyote.

Garland County has about 1,100 ponds covering about 550 acres of privately owned land. These ponds are mainly for livestock watering and sport fishing for largemouth bass, bluegills, redear sunfish, and channel catfish. About 150 small wildlife ponds are in the Ouachita National Forest.

Garland County has three larger lakes—Lake Catherine, Lake Hamilton, and Lake Ouachita. Four lakes in the community of Hot Springs Village cover 284 acres, and four municipal water supply lakes for Hot Springs cover another 217 acres. These lakes provide sport fishing for hybrid striped bass, largemouth bass, crappie, bluegills, redears, channel catfish, and other fishes.

About 56 miles of fishable streams are in the county, including the Ouachita River and Middle Fork of the Saline River. These streams provide habitat and sport fishing for largemouth bass, spotted bass, and smallmouth bass, crappie, catfish, various sunfish, and other fish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and rye.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and vetch.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and panicgrasses.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, and cedar.

Wetland plants are annual and perennial, wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, beanrushes, spikerush, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Most are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and shallow ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet, and because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations must be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to: evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 9 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. Depth to a high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, depth to a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost-action potential, and depth to a high water table affect the traffic-supporting capacity.

Sanitary Facilities

Table 10 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 10 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and that good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, depth to a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 10 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, depth to a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 10 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, depth to a water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 11 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 11, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and releases a variety of plant-available nutrients as it decomposes.

Water Management

Table 12 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives the restrictive features that affect each soil for drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering Index Properties

Table 13 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture *(9)*. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GP, GM, GC, SM, and SC; silty and clayey soils as ML, CL, MH, and CH. Soils exhibiting engineering properties of two groups can have a dual classification, for example, GM-GC.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20, or higher, for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area, or from nearby areas, and on field examination.

Physical and Chemical Properties

Table 14 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate, or component, consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They influence the soil's adsorption of cations, moisture retention, shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of movement of water through the soil when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage in each major soil layer is stated in inches of water per inch of soil. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur over a sustained period without affecting crop productivity. The rate is expressed in tons per acre per year.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 14, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 15 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission. No soil in Garland County is assigned to group A.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflowing streams, by runoff from adjacent slopes, or by inflow from high tides. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in swamps and marshes or in a closed depression is considered ponding.

Table 15 gives the frequency and duration of flooding and the time of year when flooding is most likely to occur.

Frequency, duration, and probable dates of occurrence are estimated. Frequency generally is expressed as *none, occasional,* or *frequent. None* means that flooding is not probable. *Occasional* means that flooding occurs infrequently under normal weather conditions (there is a 5 to 50 percent chance of flooding in any year). *Frequent* means that flooding occurs often under normal weather conditions (there is more than a 50 percent chance of flooding in any year). Duration is expressed as *very brief* (less than 2 days) and *brief* (2 to 7 days). The time of year that floods are most likely to occur is expressed in months. December-April, for example, means that flooding can occur during the period December through April. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information on flooding is based on evidence in the soil profile, namely, thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons, which are characteristic of soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 15 are the depth to the seasonal high water table; the kind of water table, that is, *perched;* and the months of the year that the water table commonly is highest. A water table that is seasonally high for less than 1 month is not indicated in table 15.

A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

The two numbers in the "High water table-Depth" column indicate the normal range in depth to a saturated zone. Depth is given to the nearest half foot. The first numeral in the range indicates the highest water level. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. "More than 6.0" indicates that the water table is below a depth of 6 feet or that the water table exists for less than a month.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft, rippable, or hard. If the rock is soft or rippable, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severely corrosive environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and the amount of sulfates in the saturation extract.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(10)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or on laboratory measurements. Table 16 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Ultisol.

SUBORDER. Each order is divided into suborders, primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aqult (*Aqu*, meaning wetness, plus *ult*, from Ultisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Hapludults (*Hapl*, meaning minimal horizonation, plus *udult*, the suborder of the Ultisols that has an udic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Hapludults.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is clayey, mixed, thermic Typic Hapludults.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. There can be some variation in the texture of the surface layer or of the substratum within a series. An example is the Carnasaw series, which is a member of the clayey, mixed, thermic family of Typic Hapludults.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (9)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (10)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Avant Series

The Avant series consists of moderately deep, well drained, gently sloping to very steep soils. These soils are moderately permeable. Avant soils are on sides and tops of hills, mountains, and ridges. They formed under mixed hardwoods and pine in residuum weathered from chert. The slopes range from 3 to 60 percent.

Avant soils are associated on the landscape with Bigfork and Yanush soils. Bigfork soils are in positions similar to those of the Avant soils. These soils are moderately deep to hard novaculite. Yanush soils are on sides of hills, mountains, and ridges and are deep to bedrock.

Typical pedon of Avant very gravelly silt loam, in an area of Yanush-Avant complex, 40 to 60 percent slopes; in a wooded area, SW1/4SW1/4NW1/4 sec. 3, T. 2 S., R. 18 W.

A—0 to 3 inches; dark brown (10YR 4/3) very gravelly silt loam; weak medium granular structure; very friable; common fine and very fine roots; about 45 percent, by volume, angular chert fragments less than 3 inches in diameter; very strongly acid; clear smooth boundary.

E—3 to 7 inches; yellowish brown (10YR 5/4) very gravelly silt loam; weak medium granular structure; very friable; common fine and very fine roots; about 40 percent, by volume, angular chert fragments less than 3 inches in diameter; strongly acid; clear smooth boundary.

BE—7 to 17 inches; yellowish brown (10YR 5/6) very gravelly silt loam; weak medium subangular blocky structure; very friable; common fine roots; about 35 percent, by volume, angular chert fragments less than 3 inches in diameter and about 15 percent, by volume, angular chert fragments 3 inches to 10 inches in diameter; strongly acid; gradual wavy boundary.

Bt—17 to 36 inches; strong brown (7.5YR 5/6) very cobbly silty clay loam; moderate medium subangular blocky structure; firm; few fine roots; thin patchy clay films on faces of peds; about 25 percent, by volume, angular chert fragments less than 3 inches in diameter and about 35 percent, by volume, angular chert fragments 3 inches to 10 inches in diameter; very strongly acid; abrupt irregular boundary.

R/C—36 to 42 inches; alternating strata of highly fractured, hard chert bedrock and fine earth material tilted with a dip of 45 degrees from horizontal. R material consists of highly fractured, hard chert bedrock with thin clay coatings in cracks; horizontal spacing between cracks is typically 10 centimeters or more; strata of R material range from 1 to 3 feet or more in thickness. The fine earth or C material consists of mottled yellowish brown (10YR 5/6), yellowish red (5YR 5/6), and gray (10YR 6/1) stratified clay, clay loam, and very fine sandy loam; strata of C material range from less than 1 inch to 6 inches in thickness; C material is very strongly acid.

The thickness of the solum and depth to rippable chert bedrock range from 20 to 40 inches. Because of the irregular boundary between the Bt horizon and the underlying tilted bedrock, the thickness of the solum is extremely variable within short distances. The reaction ranges from medium acid to very strongly acid.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Where the A horizon has moist value of 3 and chroma of 2 or 3, it is less than 6 inches thick. The content of coarse fragments ranges from 35 to 60 percent, by volume.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. The texture is silt loam, loam, or their very gravelly or very cobbly analogs. The content of coarse fragments ranges from 35 to 60 percent, by volume.

The BE horizon has hue of 10YR or 7.5YR, value of 5, and chroma of 4 or 6. The texture is silt loam or loam or their very gravelly or very cobbly analogs. The content of coarse fragments ranges from 35 to 60 percent, by volume. Some pedons do not have a BE horizon. The Bt horizon has hue of 10YR, 7.5YR, or 5YR, value of 5 or 6, and chroma of 4, 6, or 8; or hue of 5YR, value of 4, and chroma of 6. The texture is silt loam, silty clay loam, or clay loam or their very gravelly, extremely gravelly, or very cobbly analogs. The content of coarse fragments ranges from 35 to 80 percent, by volume.

The R/C horizon consists of alternating strata of highly fractured, hard chert bedrock and fine earth material tilted with a dip ranging from 30 degrees to near vertical. The R material is typically highly fractured, hard chert bedrock. Horizontal spacing between fractures is typically 10 centimeters or more. Because of the fractured nature of the chert bedrock, excavation can normally be made with common construction equipment. The fine earth or C material has stratified texture ranging from clay to very fine sandy loam. Colors are in shades of brown, gray, red, or yellow. Because of faulting and folding, this horizon is extremely variable within short distances.

Avilla Series

The Avilla series consists of deep, well drained, nearly level to gently sloping soils. These soils are moderately permeable. Avilla soils are on terraces. They formed under mixed hardwoods and pines in alluvium derived from residuum of siltstone, sandstone, and shale. The slopes range from 1 to 8 percent.

Avilla soils are associated on the landscape with Bonnerdale, Ceda, Leadvale, and Spadra soils. Bonnerdale soils are in upland drainageways. These soils are somewhat poorly drained, and depth to bedrock ranges from 40 to 60 inches. Ceda soils are on flood plains. These soils have a loamy-skeletal control section and do not have an argillic horizon. Leadvale soils are on terraces. These soils have a fragipan and a fine-silty control section. Spadra soils are on terraces at a slightly lower elevation than the Avilla soils. The Spadra soils have a solum that is 40 to 60 inches thick.

Typical pedon of Avilla silt loam, 1 to 3 percent slopes; in a pasture, NE1/4SE1/4NW1/4 sec. 20, T. 1 S., R. 19 W.

A—0 to 3 inches; dark yellowish brown (10YR 4/4) silt loam; moderate medium granular structure; friable; many fine and medium roots; about 5 percent, by volume, gravel fragments; medium acid; clear smooth boundary.

E—3 to 10 inches; yellowish brown (10YR 5/4) silt loam; moderate medium granular structure; friable; many fine and medium roots; about 5 percent, by volume, gravel fragments; strongly acid; clear smooth boundary.

Bt1—10 to 29 inches; yellowish red (5YR 5/8) clay loam; moderate medium subangular blocky structure; firm; common fine and medium roots; patchy clay films on faces of peds; about 7 percent, by volume, gravel fragments; very strongly acid; clear smooth boundary.

Bt2—29 to 42 inches; red (2.5YR 4/8) clay loam; common medium distinct brownish yellow (10YR 6/6) mottles; moderate medium subangular blocky structure; firm; many fine pores; few fine roots; patchy clay films on faces of peds; about 10 percent, by volume, gravel fragments; very strongly acid; clear wavy boundary.

Bt3—42 to 52 inches; red (2.5YR 5/8) gravelly clay loam; common medium distinct brownish yellow (10YR 6/6) mottles; weak medium subangular blocky structure; friable; few fine pores; patchy clay films on faces of peds and on gravel fragments; about 15 percent, by volume, gravel fragments; very strongly acid; gradual wavy boundary.

Bt4—52 to 72 inches; red (2.5YR 5/8) very gravelly clay loam; common medium distinct brownish yellow (10YR 6/6) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; friable; patchy clay films on faces of peds and on gravel fragments; about 50 percent, by volume, gravel fragments; very strongly acid.

The thickness of the solum ranges from 60 inches to 72 inches or more. The reaction is strongly acid or very strongly acid except where lime has been added.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2, 3, or 4. The A horizon is from 3 to 10 inches thick. The content of gravel fragments ranges from 1 to 10 percent, by volume.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 4. The content of gravel fragments ranges from 1 to 10 percent, by volume. Some pedons do not have an E horizon.

The Bt1 horizon has hue of 7.5YR or 5YR, value of 5, and chroma of 6 or 8, or it has hue of 5YR, value of 4, and chroma of 6. The texture is loam, clay loam, or sandy clay loam. The content of gravel fragments ranges from 1 to 10 percent, by volume. The Bt2 and Bt3 horizons have hue of 5YR or 2.5YR, value of 5, and chroma of 6 or 8, or they have hue of 2.5YR, value of 4, and chroma of 6 or 8. The texture of the Bt2 and Bt3 horizons is loam, clay loam, or sandy clay loam. The content of gravel fragments ranges from 1 to 15 percent, by volume. The Bt4 horizon has colors similar to those of the Bt2 horizon. The texture of the Bt4 horizon is very gravelly clay loam or very gravelly sandy clay loam. The content of gravel fragments ranges from 35 to 60 percent, by volume.

Bigfork Series

The Bigfork series consists of moderately deep, well drained, gently sloping to very steep soils. These soils are moderately permeable. Bigfork soils are on sides and tops of ridges and mountains. They formed under mixed hardwoods and pines in residuum weathered from novaculite. The slopes range from 3 to 60 percent.

Bigfork soils are associated on the landscape with Avant, Carnasaw, and Yanush soils. Avant soils are in positions similar to those of the Bigfork soils. These soils are moderately deep. They are underlain by rippable, fractured chert. Carnasaw soils are on the lower side slopes. These soils have a clayey control section. Yanush soils are on the sides of ridges, hills, and mountains. These soils are deep to bedrock.

Typical pedon of Bigfork stony loam, in an area of Bigfork-Rock outcrop complex, 35 to 60 percent slopes; in a wooded area, NW1/4NW1/4NW1/4 sec. 12, T. 4 S., R. 20 W.

A—0 to 4 inches; dark brown (10YR 3/3) stony loam; moderate medium granular structure; friable; many fine and medium roots; about 25 percent, by volume, angular chert fragments more than 10 inches in diameter and about 20 percent, by volume, angular chert fragments up to 10 inches in diameter; strongly acid; clear smooth boundary.

E—4 to 9 inches; yellowish brown (10YR 5/4) stony loam; moderate medium granular structure; friable; many fine and medium roots; about 15 percent, by volume, angular chert fragments more than 10 inches in diameter and about 20 percent, by volume, angular chert fragments up to 10 inches in diameter; strongly acid; clear smooth boundary.

Bt1—9 to 19 inches; yellowish red (5YR 5/8) stony clay loam; weak medium subangular blocky structure; firm; few fine and medium roots; about 30 percent, by volume, angular chert fragments more than 10 inches in diameter and about 20 percent, by volume, angular chert fragments up to 10 inches in diameter; thin patchy clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—19 to 31 inches; yellowish red (5YR 4/6) very stony clay loam; moderate medium subangular blocky structure; firm; few fine roots; about 40 percent, by volume, angular chert fragments more than 10 inches in diameter and about 15 percent, by volume, angular chert fragments up to 10 inches in diameter;

thin patchy clay films on faces of peds; very strongly acid; abrupt irregular boundary.

R—31 to 35 inches; tilted, hard, massive, novaculite bedrock.

The thickness of the solum and depth to hard bedrock range from 20 to 40 inches. Because of the irregular boundary between the Bt horizon and the underlying tilted bedrock, depth to bedrock is extremely variable within short distances. The reaction is medium acid or strongly acid in the A and E horizons and medium acid to very strongly acid in the Bt horizon.

The A horizon has hue of 10YR, value of 3, 4, or 5, and chroma of 2, 3, or 4. Where the A horizon has moist value of 3 and chroma of 2 or 3, it is less than 6 inches thick. The texture is stony loam or stony silt loam. The content of coarse fragments ranges from 35 to 60 percent, by volume. About 15 to 30 percent, by volume, is more than 10 inches in diameter.

The E horizon is 2 to 8 inches thick. It has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 4 or 6. The texture is loam, silt loam, or their very cobbly, stony, or very stony analogs. The content of coarse fragments ranges from 35 to 80 percent. Some pedons do not have an E horizon.

The Bt horizon has hue of 5YR, 7.5YR, or 10YR, value of 5, and chroma of 6 or 8, or it has hue of 5YR, value of 4, and chroma of 6. The texture is clay loam, silty clay loam, or their very cobbly, stony, or very stony analogs. The content of coarse fragments ranges from 35 to 80 percent, by volume.

Bismarck Series

The Bismarck series consists of shallow, somewhat excessively drained, gently sloping to very steep soils. These soils are moderately permeable. Bismarck soils are on sides and tops of ridges, hills, and mountains. They formed under mixed hardwoods and pine in residuum weathered from tilted shale. The slopes range from 3 to 60 percent.

Bismarck soils are associated on the landscape with Carnasaw, Clebit, and Sherless soils. These soils are in positions similar to those of the Bismarck soils. Carnasaw soils are deep and have a clayey control section. Clebit soils are shallow and are underlain by hard, tilted sandstone bedrock. Sherless soils are moderately deep and have a fine-loamy control section.

Typical pedon of Bismarck gravelly silt loam, in an area of Bismarck-Carnasaw complex, 20 to 40 percent slopes; in a forested area, SE1/4NE1/4NE1/4 sec. 31, T. 1 N., R. 20 W.

A—0 to 3 inches; dark grayish brown (10YR 4/2) gravelly silt loam; weak medium granular structure; very friable; many fine and medium roots; about 20 percent, by volume, gravel fragments and 15 percent, by volume, shale fragments; strongly acid; clear smooth boundary.

E—3 to 7 inches; brown (10YR 5/3) very channery silt loam; weak medium granular structure; friable; many fine and medium roots; about 35 percent, by volume, shale fragments and 10 percent, by volume, gravel fragments; very strongly acid; clear smooth boundary.

Bw—7 to 16 inches; yellowish brown (10YR 5/4) very channery silt loam; weak medium subangular blocky structure; friable; common fine roots; about 60 percent, by volume, shale fragments; very strongly acid; abrupt irregular boundary.

Cr—16 to 22 inches; red, brown, and gray, soft, partly weathered shale, tilted 45 degrees from horizontal.

The thickness of the solum and depth to weathered, tilted, shale bedrock range from 10 to 20 inches. The reaction is strongly acid or very strongly acid.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Where the A horizon has moist value of 3, it is less than 6 inches thick. The texture is channery silt loam or gravelly silt loam. The content of coarse fragments of sandstone or shale ranges from 15 to 35 percent, by volume.

The E horizon has hue of 10YR, value of 4 or 5, and chroma of 2, 3, or 4. The texture is very channery loam or very channery silt loam. The content of coarse fragments of shale and sandstone ranges from 35 to 60 percent, by volume.

The Bw horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 4 or 6, or it has hue of 10YR, value of 4, and chroma of 4 or 6. The texture is very channery or extremely channery silt loam or loam. The content of coarse fragments ranges from 35 to 80 percent, by volume.

The Cr horizon is red, brown, or gray, soft, partly weathered shale with a few thin strata of interbedded sandstone and siltstone. Beds are fractured, and dip ranges from 35 degrees to near vertical.

Bonnerdale Series

The Bonnerdale series consists of deep, somewhat poorly drained, level to nearly level soils. These soils are moderately permeable. Bonnerdale soils are in drainageways on uplands. They formed under mixed hardwoods and pines in loamy sediment derived from residuum of sandstone, siltstone, and shale. The slopes are 0 to 2 percent.

Bonnerdale soils are associated on the landscape with Avilla, Ceda, and Spadra soils. Avilla soils are on terraces at a higher elevation than Bonnerdale soils. Avilla soils are well drained and these soils have a solum that is more than 60 inches thick. Ceda soils are on flood plains. These soils are well drained and have a loamy-skeletal control section. Spadra soils are on terraces and are well drained.

Typical pedon of Bonnerdale fine sandy loam, occasionally flooded; in a pasture, SE1/4SE1/4NW1/4 sec. 17, T. 3 S., R. 21 W.

A—0 to 6 inches; yellowish brown (10YR 5/4) fine sandy loam; common medium distinct pale brown (10YR 6/3) mottles; moderate medium granular structure; very friable; many fine and medium roots; very strongly acid; clear smooth boundary.

Bt1—6 to 17 inches; yellowish brown (10YR 5/6) loam; common medium distinct pale brown (10YR 6/3), strong brown (7.5YR 5/8), and light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; thin patchy clay films on faces of peds and in pores; common fine and medium pores; few iron and manganese concretions; few fine roots; very strongly acid; gradual smooth boundary.

Bt2—17 to 32 inches; mottled yellowish brown (10YR 5/8), light brownish gray (10YR 6/2), and light yellowish brown (10YR 6/4) loam; moderate medium subangular blocky structure; friable; thin patchy clay films on faces of peds and in pores; common medium and fine pores; few iron and manganese concretions; few fine roots; very strongly acid; gradual smooth boundary.

Bt3—32 to 44 inches; yellowish brown (10YR 5/4) loam; common medium distinct strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) mottles; weak medium subangular blocky structure; friable; thin patchy clay films on faces of peds and in pores; common medium and fine pores; few iron and manganese concretions; very strongly acid; gradual smooth boundary.

Bt4—44 to 50 inches; pale brown (10YR 6/3) loam; common medium distinct strong brown (7.5YR 5/8) and light brownish gray (10YR 6/2) mottles and few fine prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; friable; thin patchy clay films on faces of peds and in pores; few fine and medium pores; about 5 percent, by volume, gravel fragments less than 76 millimeters or 3 inches in diameter; few iron and manganese concretions; very strongly acid; clear wavy boundary.

2BCg—50 to 54 inches; gray (10YR 6/1) channery clay loam; common medium distinct yellowish brown (10YR 5/8) and strong brown (7.5YR 5/6) mottles; weak medium subangular blocky structure; firm; few fine and medium pores; about 15 percent, by volume, shale fragments; about 15 percent, by volume, iron and manganese concretions; very strongly acid; abrupt wavy boundary.

2Cr—54 to 60 inches; weathered, fractured shale, tilted 45 degrees from the horizontal.

The thickness of the solum and depth to bedrock range from 40 to 60 inches. The reaction is strongly acid or very strongly acid.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2, 3, or 4. The content of gravel fragments ranges up to 10 percent.

The Bt1 horizon has hue of 10YR, value of 5, and chroma of 4, 6, or 8, or it has hue of 7.5YR, value of 5, and chroma of 6 or 8. Few to common mottles in shades of brown, yellow, and gray are present. The Bt2 and Bt3 horizons have colors similar to the Bt1 horizon, or they can be equally mottled in shades of brown, yellow, red, or gray. The Bt4 horizon has hue of 10YR, value of 5 or 6, and chroma of 2, 3, or 4, or it can be equally mottled in shades of brown, yellow, red, or gray. The texture of the Bt horizon is loam or sandy clay loam. The content of gravel fragments ranges up to 10 percent in the Bt horizon.

The 2BCg horizon has hue of 10YR, value of 5 or 6, and chroma of 1 or 2, or it is mottled in shades of gray, brown, and red. It is generally quite variable in short distances. The texture is loam, clay loam, or their gravelly or channery analogs. The content of sandstone and shale fragments ranges from 0 to 30 percent, by volume. The content of iron and manganese concretions ranges from 0 to 15 percent, by volume. Some pedons do not have a 2BCg horizon.

This soil is a taxadjunct to the Bonnerdale series. The base saturation of the lower part of the subsoil is slightly higher than allowed for the series; however, behavior, use, and management of these soils are similar.

Carnasaw Series

The Carnasaw series consists of deep, well drained, gently sloping to very steep soils. These soils are slowly permeable. Carnasaw soils are on sides and tops of hills, mountains, and ridges. They formed under mixed hardwoods and pine in residuum weathered from shale. The slopes range from 3 to 60 percent.

Carnasaw soils are associated on the landscape with Bigfork, Bismarck, Clebit, Pirum, and Yanush soils. Bigfork soils are on sides and tops of ridges and mountains and are moderately deep to hard bedrock. These soils have a loamy-skeletal control section. Bismarck, Clebit, and Pirum soils are in positions on the landscape similar to those of the Carnasaw soils. Bismarck and Clebit soils are shallow and have a loamy-skeletal control section. Pirum soils are moderately deep and have a fine-loamy control section. Yanush soils are on sides and foot slopes of hills, mountains, and ridges. These soils have a loamy-skeletal control section.

Typical pedon of Carnasaw stony loam, in an area of Carnasaw-Pirum-Clebit complex, 20 to 40 percent slopes; in a forested area, NW1/4SE1/4SW1/4 sec. 10, T. 1 N., R. 20 W.

A—0 to 2 inches; very dark grayish brown (10YR 3/2) stony loam; moderate medium granular structure; friable; many fine and medium roots; about 20 percent, by volume, angular fragments more than 10 inches in diameter and about 15 percent, by volume, angular fragments up to 10 inches in diameter; strongly acid; clear smooth boundary.
E—2 to 5 inches; yellowish brown (10YR 5/4) stony loam; weak medium granular structure; friable; many fine and medium roots; about 20 percent, by volume, angular fragments more than 10 inches in diameter and about 10 percent, by volume, angular fragments less than 10 inches in diameter; strongly acid; clear smooth boundary.
Bt1—5 to 11 inches; strong brown (7.5YR 5/6) silty clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; about 10 percent, by volume, angular fragments up to 10 inches in diameter; clay films on faces of peds; very strongly acid; clear smooth boundary.
Bt2—11 to 26 inches; red (2.5YR 5/8) silty clay; moderate medium subangular blocky structure; firm; about 5 percent, by volume, thin flat shale fragments; clay films on faces of peds; very strongly acid; gradual smooth boundary.
Bt3—26 to 32 inches; yellowish red (5YR 5/8) silty clay; moderate medium subangular blocky structure; firm; about 5 percent, by volume, thin flat shale fragments; clay films on faces of peds; very strongly acid; gradual smooth boundary.
BC—32 to 42 inches; strong brown (7.5YR 5/8) channery silty clay; weak medium subangular blocky structure; firm; about 30 percent, by volume, thin flat shale fragments; clay films on faces of peds; very strongly acid; clear irregular boundary.
Cr—42 to 50 inches; fractured, soft, partly weathered shale, a few thin strata of sandstone and siltstone, tilted 30 degrees from horizontal.

The thickness of the solum and depth to weathered, tilted shale bedrock range from 40 to 60 inches. The reaction is strongly acid or very strongly acid.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Where the A horizon has has moist value of 3, it is less than 6 inches thick. The texture is loam, silt loam, or their gravelly, cobbly, or stony analogs. The content of coarse fragments of sandstone, shale, and angular quartzite ranges from 15 to 35 percent, by volume. About 5 to 35 percent, by volume, is less than 10 inches in diameter and 0 to 25 percent, by volume, is more than 10 inches in diameter.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. The texture and content of coarse fragments are similar to the A horizon.

The Bt1 horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 5, and chroma of 6 or 8, or it has hue of 2.5YR or 5YR, value of 4, and chroma of 6. The texture is silty clay loam, clay loam, silty clay, or clay. The content of coarse fragments ranges from 2 to 15 percent, by volume. The Bt2 and Bt3 horizons have hue of 2.5YR or 5YR, value of 5, and chroma of 6 or 8, or they have value of 4 and chroma of 6. The texture is silty clay or clay. The content of coarse fragments ranges from 2 to 10 percent, by volume. The BC horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 5, and chroma of 6 or 8, or it has hue of 2.5YR or 5YR, value of 4, and chroma of 6. Mottles are in shades of red, brown, or gray. Some pedons may be equally mottled in shades of red, yellow, brown, and gray. The texture is silty clay, clay, or their channery or gravelly analogs. The content of coarse fragments of sandstone or shale ranges from 5 to 35 percent, by volume.

The Cr horizon is red, brown, or gray, soft, partly weathered shale with a few thin strata of interbedded sandstone and siltstone. Beds are fractured and tilted more than 20 degrees from horizontal.

Ceda Series

The Ceda series consists of deep, well drained, nearly level soils. These soils are rapidly permeable. Ceda soils are on flood plains. These soils formed under mixed hardwoods and pine in loamy alluvium with a high content of gravel. The slopes are 0 to 3 percent.

Ceda soils are associated on the landscape with Avilla, Bonnerdale, Leadvale, and Spadra soils. Avilla soils are on terraces. These soils have a fine-loamy control section and an argillic horizon. Bonnerdale soils are in drainageways on uplands. These soils are somewhat poorly drained and have a coarse-loamy control section. Leadvale soils are on terraces. These soils have a fine-silty control section and a fragipan. Spadra soils are on terraces. These soils have an argillic horizon and a fine-loamy control section.

Typical pedon of Ceda gravelly loam, frequently flooded; in a wooded area, SE1/4SW1/4 SE1/4 sec. 29, T. 1 S., R. 20 W.

A—0 to 6 inches; dark brown (10YR 4/3) gravelly loam; moderate medium granular structure; very friable; many fine and medium roots; about 30 percent, by volume, sandstone, quartz, and shale fragments less than 3 inches in diameter; medium acid; clear wavy boundary.
C1—6 to 24 inches; yellowish brown (10YR 5/4) very gravelly loam; massive; friable; common fine and medium roots; about 40 percent, by volume, sandstone, quartz, and shale fragments less than 3 inches in diameter and about 10 percent, 3 to 10 inches in diameter; medium acid; diffuse wavy boundary.
C2—24 to 72 inches; yellowish brown (10YR 5/4) very gravelly loam; massive; friable; about 40 percent, by volume, sandstone, quartz, and shale fragments less

than 3 inches in diameter, about 10 percent, 3 to 10 inches in diameter, and about 10 percent more than 10 inches in diameter; medium acid.

The depth to bedrock is more than 60 inches. The reaction is slightly acid or medium acid.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The content of coarse fragments ranges from 15 to 35 percent, by volume.

The C horizon has hue of 10YR, value of 4, 5, or 6, and chroma of 4 or 6, or it has chroma of 7.5YR, value of 5, and chroma of 4 or 6. The texture is loam, fine sandy loam, or their very gravelly, extremely gravelly, or cobbly analogs. The content of coarse fragments ranges from 35 to 85 percent, by volume. About 35 to 70 percent is less than 3 inches in diameter, and 0 to 20 percent is more than 3 inches in diameter.

Clebit Series

The Clebit series consists of shallow, well drained, gently sloping to very steep soils. These soils are moderately rapidly permeable. Clebit soils are on sides and tops of hills, mountains, and ridges. They developed under mixed hardwoods and pine in residuum weathered from sandstone. The slopes range from 3 to 60 percent.

Clebit soils are associated on the landscape with Bismarck, Carnasaw, Pirum, and Sherless soils. These soils are on in positions similar to those of the Clebit soils. Bismarck soils are shallow and are underlain by soft, weathered, shale bedrock. Carnasaw soils are deep and have a clayey control section. Pirum soils are moderately deep and have a fine-loamy control section. Sherless soils are moderately deep and have a fine-loamy control section.

Typical pedon of Clebit bouldery loam, from an area of Clebit-Pirum-Rock outcrop complex, 3 to 15 percent slopes; on a wooded mountain ridgetop, NE1/4NW1/4 NE1/4 sec. 16, T. 1 N., R. 20 W.

A—0 to 6 inches; very dark grayish brown (10YR 3/2) bouldery loam; moderate medium granular structure; friable; many fine and medium roots; about 15 percent, by volume, sandstone fragments more than 24 inches in diameter, about 10 percent, by volume, angular sandstone fragments, 10 to 24 inches in diameter, about 35 percent, by volume, angular sandstone fragments up to 10 inches in diameter; strongly acid; clear smooth boundary.

Bw—6 to 12 inches; dark yellowish brown (10YR 4/4) stony loam; moderate medium granular structure; friable; common fine and medium roots; about 25 percent, by volume, angular sandstone fragments more than 10 inches in diameter, about 35 percent, by volume, angular sandstone fragments up to 10 inches in diameter; very strongly acid; abrupt irregular boundary.

R—12 to 24 inches; hard, massive, fractured, sandstone bedrock, tilted about 35 degrees from horizontal.

The thickness of the solum and depth to hard sandstone bedrock range from 10 to 20 inches. The reaction is strongly acid or very strongly acid.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Where the A horizon has moist value of 3, it is 6 inches or less thick. The texture is loam, fine sandy loam, or their very gravelly, stony, very stony, or bouldery analogs. The coarse sandstone fragments range from 35 to 70 percent, by volume. About 35 to 50 percent, by volume, is less than 10 inches in diameter; 0 to 25 percent, by volume, is more than 10 inches in diameter; and 0 to 15 percent, by volume, is more than 24 inches in diameter.

The Bw horizon has hue of 10YR or 7.5YR, value of 4, and chroma of 4, or it has value of 5 and chroma of 4 or 6. Texture is loam, fine sandy loam, or their very gravelly, bouldery, or stony analogs. The content of coarse fragments is similar to the A horizon.

The R layer is grayish, yellowish, or brownish sandstone that is hard, massive, fractured, and tilted more than 20 degrees from horizontal.

Leadvale Series

The Leadvale series consists of deep, moderately well drained, nearly level soils on terraces. These soils are slowly permeable. They formed under mixed oaks and pine in alluvium derived from residuum of siltstone, sandstone, and shale. Slopes range from 1 to 3 percent.

Leadvale soils are associated on the landscape with Avilla, Ceda, and Mazarn soils. These soils do not have a fragipan. Avilla soils are on terraces and have a fine-loamy control section. Ceda soils are on flood plains and are well drained. Mazarn soils are on low terraces at a lower elevation than the Leadvale soils and are moderately deep.

Typical pedon of Leadvale silt loam, 1 to 3 percent slopes; in a pine plantation, NE1/4NE1/4SE1/4 sec. 6, T. 1 S., R. 22 W.

A—0 to 2 inches; dark brown (10YR 4/3) silt loam; weak fine granular structure; very friable; many fine and medium roots; strongly acid; clear smooth boundary.

E—2 to 6 inches; yellowish brown (10YR 5/4) silt loam; weak fine subangular blocky structure; friable; many fine and medium roots; very strongly acid; clear smooth boundary.

Bt1—6 to 20 inches; yellowish brown (10YR 5/6) silt loam; moderate medium subangular blocky structure; friable; few fine roots; patchy clay films on faces of peds; very strongly acid; clear smooth boundary.

Bt2—20 to 29 inches; yellowish brown (10YR 5/6) silty clay loam; few medium distinct brown and yellowish red mottles; moderate medium subangular blocky structure; firm; patchy clay films on faces of peds; very strongly acid; clear smooth boundary.

Btx—29 to 48 inches; mottled yellowish brown (10YR 5/6), light brownish gray (10YR 6/2), and strong brown (7.5YR 5/6) silty clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; very firm and brittle; patchy clay films on faces of peds; very strongly acid; gradual wavy boundary.

BCt—48 to 60 inches; mottled light brownish gray (10YR 6/2), yellowish brown (10YR 5/6), and yellowish red (5YR 5/6) silty clay loam; moderate medium subangular blocky structure; firm; patchy clay films on faces of peds; about 10 percent, by volume; soft shale fragments; very strongly acid.

Cr—60 to 72 inches; partly weathered shale.

The thickness of the solum and depth to bedrock range from 48 to 72 inches or more. Depth to the fragipan ranges from 16 to 38 inches. The reaction is strongly acid or very strongly acid.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Where the A horizon has moist value of 3, it is less than 6 inches thick.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. Some pedons do not have an E horizon.

The Bt horizon has hue of 10YR or 7.5YR, value of 5 or 6, and chroma of 6 or 8. The texture is silt loam or silty clay loam. Some pedons have mottles in shades of red or brown in the lower part of the Bt horizon. The Btx horizon has hue of 10YR, value of 5 or 6, and chroma of 6 or 8, or value of 6 and chroma of 4, or it has hue of 7.5YR, value of 5, and chroma of 6 or 8. Some pedons do not have a matrix and are mottled in shades of brown, gray, red, and yellow. The texture is silty clay loam or silt loam.

The characteristics of the horizon below the fragipan are variable. This horizon ranges from a BC horizon with color and textures similar to the Btx horizon to a Cr horizon of weathered shale.

Magnet Series

The Magnet series consists of moderately deep, well drained, moderately steep to steep soils on uplands. These soils are loamy and moderately slowly permeable. They are on sides and tops of ridges of a ring dike complex in the Ouachita Mountains. They formed in residuum from syenite and other intrusive igneous rocks. The slopes range from 15 to 40 percent.

Magnet soils are associated on the landscape with Bismarck, Carnasaw, Clebit, and Sherless soils. All of the associated soils are outside the dike complex. Bismarck and Clebit soils have a loamy-skeletal control section. Bismarck soils are shallow to shale bedrock. Clebit soils are shallow to sandstone bedrock. Carnasaw soils are deep and formed in residuum from shale. Sherless soils have a fine-loamy control section and formed in residuum of sandstone.

Typical pedon of Magnet loam, 15 to 40 percent slopes; in a forest, NW1/4NW1/4SW1/4 sec. 17, T. 3 S., R. 18 W.

A1—0 to 2 inches; dark reddish brown (5YR 3/3) loam; weak fine granular structure; friable; many fine roots; 10 percent, by volume, subrounded coarse fragments less than 3 inches in diameter; strongly acid; clear smooth boundary.

A2—2 to 6 inches; dark reddish brown (5YR 3/4) loam; weak medium subangular blocky structure; friable; many fine roots; 10 percent, by volume, subrounded coarse fragments less than 3 inches in diameter; strongly acid; clear smooth boundary.

Bt1—6 to 22 inches; red (2.5YR 4/6) clay loam; moderate medium subangular blocky structure; firm; thin patchy clay films on faces of peds; 5 percent, by volume, subrounded coarse fragments less than 3 inches in diameter; strongly acid; gradual smooth boundary.

Bt2—22 to 30 inches; red (2.5YR 4/6) clay loam; strong medium subangular blocky structure; firm; thin continuous clay films on faces of peds; dark stains on some faces of peds; 5 percent, by volume, subrounded coarse fragments less than 3 inches in diameter; about 30 percent, by volume, small irregularly shaped pockets of soft, multicolored syenitic saprolite; strongly acid; abrupt irregular boundary.

Cr/Bt—30 to 72 inches; soft, multicolored syenitic saprolite; about 10 percent of mass is soil in seams about 2 inches wide and 24 inches apart; the soil is red (2.5YR 4/6) clay; moderate medium subangular blocky structure; firm; thin continuous clay films on faces of peds; strongly acid.

The thickness of the solum and depth to soft, weathered bedrock range from 20 to 50 inches and are extremely variable in short distances. Depth to hard bedrock is more than 60 inches. The reaction ranges from slightly acid to strongly acid.

The A horizon has hue of 7.5YR, value of 4, and chroma of 2 or 4, or it has hue of 5YR, value of 3 or 4, and chroma of 2, 3, or 4. The content of coarse fragments ranges from 0 to 15 percent, by volume. Where an A horizon has value of 3, it is less than 6 inches thick.

The Bt horizon has hue of 5YR, value of 4 or 5, and chroma of 3, 4, or 6, or it has hue of 2.5YR, value of 4 or 5, and chroma of 4 or 6. The content of coarse fragments ranges from 0 to 30 percent, by volume. The texture is silty clay loam, silty clay, clay, clay loam, or their gravelly or cobbly analogs.

The Cr horizon is extremely variable over short distances. It is dominantly soft, multicolored syenitic saprolite and other igneous rocks of variable mineral composition.

Mazarn Series

The Mazarn series consists of moderately deep, somewhat poorly drained, level to nearly level soils on low terraces. These soils are moderately slowly permeable. They formed under mixed hardwoods and pines in loamy sediment derived from residuum of shale, siltstone, and sandstone. The slopes range from 0 to 2 percent.

Mazarn soils are associated on the landscape with Avilla, Bismarck, Carnasaw, Ceda, Leadvale, and Spadra soils. Avilla and Spadra soils are on terraces. They are deep and well drained. Bismarck soils are on adjacent uplands. They are well drained and shallow to shale bedrock. Carnasaw soils are on adjacent uplands. These soils are well drained and have a clayey control section. Ceda soils are on flood plains. They have a loamy-skeletal control section and are well drained. Leadvale soils are on terraces. These soils are deep and have a fragipan.

Typical pedon of Mazarn silt loam, occasionally flooded; in a pasture, SE1/4NW1/4 SW1/4 sec. 28, T. 2 S., R. 20 W.

A—0 to 4 inches; yellowish brown (10YR 5/4) silt loam; weak medium subangular blocky structure; friable; common fine and medium roots; many fine and medium pores; strongly acid; clear smooth boundary.

Bt1—4 to 14 inches; light yellowish brown (2.5Y 6/4) silt loam; common medium distinct pale brown (10YR 6/3) mottles; weak medium subangular blocky structure; friable; patchy thin clay films on faces of peds; many fine and medium roots; common fine and medium pores; few iron and manganese concretions; strongly acid; gradual smooth boundary.

Bt2—14 to 30 inches; brownish yellow (10YR 6/8) silt loam; many medium distinct light brownish gray (10YR 6/2) mottles; moderate medium subangular blocky structure; friable; patchy thin clay films on faces of peds; common fine and medium roots; few fine and medium pores; few iron and manganese concretions; strongly acid; clear smooth boundary.

Bt3—30 to 36 inches; light brownish gray (10YR 6/2) silty clay loam; common medium distinct brownish yellow (10YR 6/6) and strong brown (7.5YR 5/8) mottles; moderate medium subangular blocky structure; patchy thin clay films on faces of peds; few fine roots; few fine and medium pores; common iron and manganese concretions; about 10 percent, by volume, shale fragments; very strongly acid; abrupt irregular boundary.

Cr—36 to 40 inches; gray, weathered shale, tilted 20 degrees from horizontal.

The thickness of the solum and depth to bedrock range from 20 to 40 inches. The reaction is strongly acid or very strongly acid.

The A horizon has hue of 10YR, value of 4 or 5, and chroma of 2, 3, or 4, or it has hue of 2.5Y, value of 5, and chroma of 2 or 4.

Some pedons have an E horizon. It has hue of 10YR, value of 5 or 6, and chroma of 3 or 4, or it has hue of 2.5Y, value of 5 or 6, and chroma of 4. The texture is loam or silt loam.

The Bt1 horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4, or it has hue of 2.5Y, value of 5 or 6, and chroma of 4 or 6. Mottles are in shades brown, gray, or yellow. The texture is silt loam, loam, or silty clay loam. The Bt2 horizon has hue of 10YR, value of 5 or 6, and chroma of 4, 6, or 8; hue of 2.5Y, value of 5 or 6, and chroma of 4; or it is equally mottled in shades of brown, gray, and yellow. Mottles are in shades of brown, gray, and yellow. Texture is silt loam, loam, or silty clay loam. Coarse fragment content ranges from 0 to 10 percent. The Bt3 horizon has hue of 10YR, value of 5 or 6, and chroma of 2; hue of 2.5Y, value of 5 or 6, and chroma of 2 or 4; or it is equally mottled in shades of brown, gray and yellow. The texture is silt loam, loam, or silty clay loam, or their gravelly or channery analogs. The content of coarse fragments ranges from 0 to 30 percent, by volume.

The Cr horizon is weathered, tilted shale. Beds are fractured, and tilt is 20 degrees or more from horizontal.

Pirum Series

The Pirum series consists of moderately deep, well drained, gently sloping to very steep soils on sides and tops of hills, mountains, and ridges. These soils are moderately permeable. They developed under mixed hardwoods and pine in residuum weathered from fractured and tilted sandstone. The slopes range from 3 to 60 percent.

Pirum soils are associated on the landscape with Carnasaw and Clebit soils, which are in a position similar to that of the Pirum soils. Carnasaw soils are deep and have a clayey control section. Clebit soils are shallow and have a loamy-skeletal control section.

Typical pedon of Pirum stony loam, from an area of Pirum-Clebit-Carnasaw complex, 40 to 60 percent slopes; in a wooded area, NE1/4NW1/4 NE1/4 sec. 6, T. 2 S., R. 20 W.

A—0 to 4 inches; dark brown (10YR 4/3) stony loam; moderate medium granular structure; friable: about 25 percent, by volume, sandstone fragments more than 10 inches in diameter and about 10 percent, by volume, sandstone fragments less than 10 inches in diameter; strongly acid; clear smooth boundary.

E—4 to 10 inches; light yellowish brown (10YR 6/4) loam; weak medium subangular blocky structure; friable; about 10 percent, by volume, sandstone fragments less than 10 inches in diameter; very strongly acid; clear smooth boundary.

Bt1—10 to 25 inches; yellowish brown (10YR 5/6) loam; weak medium subangular blocky structure; friable; patchy thin clay films on faces of peds; about 5 percent, by volume, sandstone fragments less than 10 inches in diameter; very strongly acid; gradual smooth boundary.

Bt2—25 to 40 inches; strong brown (7.5YR 5/6) clay loam; moderate medium subangular blocky structure; firm; patchy distinct clay films on faces of peds; about 5 percent, by volume, sandstone fragments less than 10 inches in diameter; very strongly acid; abrupt irregular boundary.

R—40 to 50 inches; fractured, hard sandstone bedrock, tilted about 45 degrees from horizontal.

The thickness of the solum and depth to sandstone bedrock range from 22 to 50 inches. The reaction is strongly acid or very strongly acid.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Where the moist value is 3, the A horizon is less than 6 inches thick. The texture is loam or the cobbly, stony, or very stony analogs. The content of coarse fragments, mainly sandstone, ranges from 15 to 50 percent, by volume. About 15 to 35 percent, by volume, is less than 10 inches in diameter and 0 to 40 percent, by volume, is more than 10 inches in diameter.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 3 or 4. The texture is loam, fine sandy loam, or their gravelly or cobbly analogs. The content of coarse fragments, mainly sandstone, ranges from 0 to 25 percent, by volume. Some pedons do not have an E horizon.

The Bt horizon has hue of 10YR or 7.5YR, value of 5, and chroma of 6 or 8, or it has hue of 5YR, value of 4, and chroma of 6. The texture of the Bt horizon is loam, sandy clay loam, or clay loam. The content of coarse fragments, mainly sandstone, ranges from 0 to 25 percent, by volume. The lower part of the Bt horizon has an irregular boundary over tilted and fractured sandstone bedrock, and depth to bedrock is extremely variable within short distances.

Sherless Series

The Sherless series consists of moderately deep, well drained, gently sloping to steep soils on sides and tops of low ridges. These soils are moderately permeable. They formed under mixed hardwoods and pine in residuum weathered from sandstone or interbedded sandstone and shale. The slopes range from 3 to 30 percent.

Sherless soils are associated on the landscape with Bismarck, Carnasaw, and Clebit soils, which are in positions similar to those of the Sherless soils. Bismarck soils are shallow and are underlain by soft shale. They have a loamy-skeletal control section. Carnasaw soils are deep and have a clayey control section. Clebit soils are shallow and are underlain by hard sandstone. They have a loamy-skeletal control section.

Typical pedon of Sherless gravelly fine sandy loam, from an area of Sherless-Clebit complex, 12 to 30 percent slopes; in a pasture, NW1/4NE1/4SW1/4 sec. 5, T. 4 S., R. 20 W.

A—0 to 5 inches; dark brown (10YR 4/3) gravelly fine sandy loam; weak medium granular structure; friable; many fine and medium roots; about 15 percent, by volume, gravel fragments; strongly acid; clear smooth boundary.

E—5 to 11 inches; light yellowish brown (10YR 6/4) gravelly fine sandy loam; moderate medium granular structure; friable; many fine and medium roots; about 15 percent, by volume, gravel fragments; very strongly acid; clear smooth boundary.

Bt1—11 to 26 inches; yellowish red (5YR 5/8) clay loam; weak medium subangular blocky structure; firm; common fine and medium roots; discontinuous clay films on faces of peds; about 10 percent, by volume, sandstone fragments; very strongly acid; gradual wavy boundary.

Bt2—26 to 39 inches; yellowish red (5YR 5/6) gravelly sandy clay loam; weak medium subangular blocky structure; firm; very fine and medium roots; discontinuous clay films on faces of peds; about 15 percent, by volume, small sandstone fragments; very strongly acid; clear wavy boundary.

Cr—39 to 42 inches; weathered, soft, fractured sandstone; variegated in shades of brown, red, and gray.

The thickness of the solum and depth to soft, weathered sandstone bedrock range from 20 to 40 inches. The reaction is strongly acid or very strongly acid. The content of coarse fragments of gravel ranges from 5 to 20 percent, by volume, throughout the solum.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2 or 3. Where the moist value is 3, the A horizon is less than 6 inches thick.

The E horizon has hue of 10YR, value of 5 or 6, and chroma of 4 or 6. The texture is fine sandy loam or gravelly fine sandy loam.

The Bt horizon has hue of 5YR or 7.5YR, value of 5, and chroma of 6 or 8. Mottles in shades of red and brown range from none to many in the lower part of the Bt horizon. The texture is clay loam, sandy clay loam, or their gravelly analogs.

The Cr horizon is weathered, soft, fractured sandstone or interbedded sandstone and shale. The color is typically variegated in shades of brown, red, and gray.

Spadra Series

The Spadra series consists of deep, well drained, nearly level soils on terraces. These soils are moderately permeable. They formed under mixed hardwoods and pine in loamy alluvium derived from residuum of sandstone, shale, and siltstone. The slopes range from 0 to 2 percent.

Spadra soils are associated on the landscape with Avilla, Bonnerdale, Ceda, and Leadvale soils. Avilla soils are on terraces at a slightly higher elevation than Spadra soils. Avilla soils have a solum that is more than 60 inches thick. Bonnerdale soils are in upland drainageways and are somewhat poorly drained. Ceda soils are on flood plains. These soils have a loamy-skeletal control section and do not have an argillic horizon. Leadvale soils are on terraces and they have a fragipan and a fine-silty control section.

Typical pedon of Spadra loam, occasionally flooded; in a pine forest, SE1/4NW1/4SW1/4 sec. 34, T. 1 N., R. 22 W.

A—0 to 3 inches; dark brown (10YR 4/3) loam; moderate medium granular structure; very friable; many fine and medium roots; strongly acid; clear smooth boundary.

Bt1—3 to 13 inches; yellowish red (5YR 4/6) loam; weak medium subangular blocky structure; friable; many fine and medium roots; thin patchy clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt2—13 to 29 inches; yellowish red (5YR 4/6) clay loam; moderate medium subangular blocky structure; firm; common fine and medium roots; patchy distinct clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt3—29 to 39 inches; yellowish red (5YR 5/6) clay loam; weak medium subangular blocky structure; firm; few fine and medium roots; patchy distinct clay films on faces of peds; very strongly acid; gradual smooth boundary.

Bt4—39 to 48 inches; strong brown (7.5YR 5/6) clay loam; weak medium subangular blocky structure; friable; patchy faint clay films on faces of peds; few black and brown stains on faces of peds; very strongly acid; gradual smooth boundary.

BC—48 to 60 inches; strong brown (7.5YR 5/6) loam; weak medium subangular blocky structure; friable; few black and brown stains on faces of peds; very strongly acid; gradual wavy boundary.

C—60 to 72 inches; strong brown (7.5YR 5/6) loam; massive; friable; few black and brown stains; very strongly acid.

The thickness of the solum ranges from 40 to 60 inches, and depth to bedrock is more than 72 inches. The reaction is strongly acid or very strongly acid. The content of coarse fragments, up to 3 inches in diameter, ranges from 0 to 10 percent, by volume, in the A horizon; 0 to 5 percent in the Bt horizon; and 0 to 20 percent in the BC and C horizons.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2, 3, or 4. Where the moist value is 3 and chroma is 3 or less, the A horizon is less than 6 inches thick.

The Bt horizon has hue of 5YR or 7.5YR, value of 5, and chroma of 6 or 8, or it has hue of 5YR, value of 4, and chroma of 6. The texture is loam, clay loam, or sandy clay loam. Mottles in shades of brown, red, and yellow range from none to common in the lower part of the Bt horizon.

The BC horizon has hue of 5YR, 7.5YR, or 10YR, value of 5, and chroma of 4, 6, or 8, or it has value of 4 and chroma of 4. The texture is loam, fine sandy loam, sandy loam, or their gravelly analogs.

The C horizon is similar to the BC horizon in color and texture.

Yanush Series

The Yanush series consists of deep, well drained, gently sloping to very steep soils on sides and foot slopes of hills, mountains, and ridges. These soils are moderately permeable. They formed under mixed hardwoods and pine in colluvium from chert and novaculite. The slopes range from 3 to 60 percent.

Yanush soils are associated on the landscape with Avant, Bigfork, and Carnasaw soils. Avant soils are on sides and tops of ridges, hills, and mountains, These soils are moderately deep over rippable, fractured chert. Bigfork soils are on sides and tops of ridges and mountains. They are moderately deep over hard novaculite. Carnasaw soils are on sides of ridges, hills, and mountains, and they have a clayey control section.

Typical pedon of Yanush very gravelly silt loam, from an area of Yanush-Avant complex, 40 to 60 percent slopes; in a wooded area, SE1/4SE1/4SW1/4 sec. 24, T. 1 N., R. 20 W.

A—0 to 3 inches; dark grayish brown (10YR 4/2) very gravelly silt loam; weak medium granular structure; friable; many fine and medium roots; about 40 percent, by volume, chert fragments less than 3 inches in diameter and about 10 percent, by volume, more than 3 inches in diameter; medium acid; clear smooth boundary.

E—3 to 5 inches; brown (7.5YR 4/4) very gravelly silt loam; weak medium granular structure; friable; many fine and medium roots; about 40 percent, by volume, chert fragments less than 3 inches in diameter and about 10 percent, by volume, more than 3 inches in diameter; very strongly acid; clear smooth boundary.

Bt1—5 to 29 inches; strong brown (7.5YR 5/6) very gravelly silty clay loam; weak medium subangular blocky structure; firm; common fine and medium roots; thin patchy clay films on faces of peds; about 50 percent, by volume chert fragments less than 3 inches in diameter and 10 percent, by volume, 3 to 10 inches in diameter; very strongly acid; gradual smooth boundary.

Bt2—29 to 44 inches; strong brown (7.5YR 5/8) very gravelly silty clay loam; weak medium subangular blocky structure; firm; common fine and few medium roots; thin patchy clay films on faces of peds; about 50 percent, by volume, chert fragments less than 3 inches in diameter and 10 percent, by volume, 3 to 10 inches in diameter; very strongly acid; gradual smooth boundary.

Bt3—44 to 72 inches; strong brown (7.5YR 5/6) extremely gravelly silty clay loam; weak medium subangular blocky structure; firm; common fine roots; thin patchy clay films on faces of peds; about 50 percent, by volume, chert fragments less than 3 inches in diameter and about 20 percent, by volume, chert fragments that range from 3 to 10 inches in diameter; very strongly acid.

The thickness of the solum is more than 60 inches. The reaction of the A horizon is medium acid or strongly acid, the E horizon ranges from medium acid to very strongly acid, and the Bt horizon is strongly acid or very strongly acid.

The A horizon has hue of 10YR, value of 3 or 4, and chroma of 2, 3, or 4. Where the moist value is 3, the A horizon is less than 6 inches thick. The texture is silt loam or the gravelly, very gravelly, cobbly, or stony analogs. The content of coarse fragments of chert and novaculite ranges from 25 to 60 percent, by volume. About 15 to 40 percent, by volume, is less than 3 inches in diameter and 10 to 30 percent, by volume, is more than 3 inches in diameter.

The E horizon has hue of 10YR or 7.5YR, value of 4, 5, or 6, and chroma of 4, or it has hue of 10YR, value of 5 or 6, and chroma of 3. The texture and content of coarse fragments are similar to the A horizon.

The Bt horizon has hue of 2.5YR, 5YR, or 7.5YR, value of 5, and chroma of 6 or 8, or it has hue of 2.5YR or 5YR, value of 4, and chroma of 6. The texture is silty clay loam, clay loam, or the very gravelly or extremely gravelly analogs. The content of coarse fragments of chert and novaculite ranges from 35 to 90 percent, by volume. About 25 to 70 percent, by volume, is less than 3 inches in diameter and 10 to 20 percent, by volume, is more than 3 inches in diameter.

Formation of the Soils

In this section, the factors of soil formation are discussed and related to the soils in the survey area. In addition, the processes of soil formation are described.

Factors of Soil Formation

Soil is formed by weathering and other processes that act upon the soil. The characteristics of the soil at any given point depend upon climate, living organisms, parent material, relief, and time. Each factor acts on the soil and modifies the effect of the other four. When climate, living organisms, or any other one of the five factors is varied to a significant extent, a different soil may be formed.

Climate and living organisms are the active forces in soil formation. Relief modifies the effects of climate and living organisms, mainly by its influence on temperature and runoff. Because climate, vegetation, parent material, and relief interact over time, time is the fifth factor of soil formation. Thus, the effect of time is also reflected in the soil characteristics.

The interaction of the five factors of soil formation is more complex for some soils than for others *(8)*. The five factors and how they interact to form some of the soils in Garland County are discussed in the following paragraphs.

Parent Material

Soils in Garland County formed in three broad classes of parent material: residuum, colluvium, and alluvium. The kind of material influences the rate at which the soil forms; the physical, chemical, and mineral composition of the soil; and the color of the soil.

Most of the parent material consists of material weathered from sandstone, shale, chert, or novaculite. Most of the sandstone and shale are interbedded with a tilt of 20 degrees or more caused by folding and faulting. The chert bedrock, which is extremely fractured, and novaculite, which is hard and massive, are also tilted 20 degrees or more.

Clebit, Pirum, and Sherless soils formed in material weathered from sandstone. Bismarck and Carnasaw soils formed in material weathered from shale. Bigfork soils formed in material weathered from novaculite. Avant soil formed in material derived from fractured chert, and Yanush soil formed in colluvium derived from novaculite and chert.

Sediment deposited by the Ouachita River, North Fork Creek, Middle Fork, Glazypeau Creek, Little Mazarn Creek, Mazarn Creek, and other small streams is the parent material of soils on terraces, flood plains, and in drainageways. This alluvium is a mixture of material derived from several different kinds of soil, rock, and unconsolidated material. It was transported by water from uplands in Garland County and from counties to the west and north. Avilla, Bonnerdale, Ceda, Leadvale, Spadra, and Mazarn soils formed in this material.

Climate

The climate of Garland County is characterized by relatively cool winters, warm to hot summers, and fairly abundant rainfall. The climate probably is similar to the climate under which the soils in the county formed. The average daily maximum temperature is 93.3 degrees in July and 51.6 degrees in January. Annual precipitation is about 55 inches and generally is well distributed throughout the year. For additional information about the climate of Garland County, refer to the section, "General Nature of Garland County."

The warm, moist climate of the county promotes rapid soil formation and encourages rapid chemical reaction. The large amount of water that moves through the soil is instrumental in moving dissolved or suspended materials downward in the soil profile. Plant remains decompose rapidly, and the organic acid that forms hastens the removal of carbonates and the formation of clay. Because the soil is frozen only to a shallow depth and for a relatively short period, soil formation continues almost the year round. The climate throughout the county is relatively uniform, although its effect is modified locally by elevation and slope aspect. Climate alone does not account for differences in the soils in the survey area.

Living Organisms

The higher plants and animals, as well as insects, bacteria, and fungi, are important in the formation of soils. Among the effects of living organisms are the addition of organic matter and nitrogen to the soil, gains or losses in plant nutrients, and changes in soil structure and porosity.

Before Garland County was settled, the native vegetation had more influence on soil formation than did animal activity.

The level and nearly level areas in the broad valleys in the county supported a growth of tall bunch grasses and hardwood trees. Bonnerdale, Leadvale, and Mazarn soils formed in these areas. These soils, however, do not have the thick, dark color surface layer commonly associated with soils formed under this type of vegetation. Apparently, their characteristics were influenced more by parent material, climate, and relief than by vegetation.

In the narrow valleys and along the streams on the flood plains, mixed pines and hardwoods were native on the deeper soils. Ceda, Avilla, and Spadra soils formed in these areas. These soils differ chiefly in age, relief, and degree of weathering.

The valley and ridges of the southern part of the survey area had mixed stands mainly of shortleaf pine, southern red oak, white oak, hickory, and blackgum. Sherless and Carnasaw soils formed under this type of forest cover. Where bedrock is at a shallow depth, Bismarck and Clebit soils formed under a cover of scattered post oak and blackjack oak with an understory of tall grasses, such as big bluestem, little bluestem, and indiangrass.

The native vegetation in most of the mountainous areas in the county consisted of a forest of upland oaks, hickory, redcedar, and shortleaf pine. In these areas, only the upper few inches of the soils have a significant accumulation of organic matter and are a dark color. Avant, Carnasaw, Pirum, Yanush, Bigfork, Bismarck, and Clebit soils formed on these uplands. They differ chiefly in age and degree of weathering, in relief, and in the kind of parent material. Differences in native vegetation on the uplands appear to be related mainly to variations in the available water.

Man is most important to the future rate and direction of soil formation. He clears the forests, cultivates the soils, and introduces new kinds of plants. He adds fertilizer, lime, and chemicals to the soil for insect, disease, and weed control. Building levees for flood control, improving drainage, grading and smoothing the surface, and controlling fire also affect the future formation of soils. Some results may not be evident for many centuries. Nevertheless, the complex of living organisms affecting soil formation in this survey area has been drastically changed by man.

Relief

Relief or differences in elevation in Garland County is the result of the compression and uplift of Paleozoic rocks and the subsequent erosion and entrenchment of streams and drainage channels into the land surface. The highest elevation in the county, about 1,961 feet above sea level, is the Ouachita Pinnacle in north-central Garland County. The lowest elevation, about 305 feet above sea level, is in the southeastern corner of Garland County where Lake Catherine extends into Hot Spring County.

Some of the greatest differences in the soils of Garland County are caused by the effect of relief on drainage, runoff, erosion, and percolation of water through the soil. Relief ranges from almost vertical bluffs to broad flats.

Generally, the steeper soils and those on narrow ridges are shallow because they have lost so much soil material through geologic erosion. An example is the Clebit soils. In contrast, broad areas of the nearly level or gently sloping soils have lost little soil material, and the soils are deep. Examples are Avilla, Carnasaw, and Leadvale soils.

In coves and on foot slopes are deep accumulations of material that washed or slid down from adjoining steep slopes. The Yanush soils are in such spots. These soils are stony in places where rocks have broken off and rolled downslope.

Slopes on tops and sides of ridges are shaped so that excess water is removed soon after it falls on the surface. Even when precipitation is more than sufficient to saturate, the soils are saturated for only short periods during and after rainfall or snowfall. Consequently, the soils are moderately well drained or well drained, though some are slowly permeable. This is reflected by the dominantly brown or red colors of Carnasaw, Pirum, Clebit, Bigfork, and Avant soils that formed on these ridges.

Slopes within the valleys generally have less gradient than those on ridges. Generally, the soils in the valleys are accumulations of material washed or sloughed down from adjacent higher soils. Bonnerdale and Mazarn soils formed in this material where surface drainage was impeded, and the Leadvale soils formed in areas of more normal relief.

Spadra and Avilla soils, which are on level to gently sloping stream terraces, formed in deep loamy material washed from uplands and redeposited on stream flood plains before the streams were further entrenched.

Level to nearly level soils, such as Ceda soils, are on flood plains along streams and are subject to frequent flooding.

Time

The time required for soil formation depends largely on other factors of soil formation. Less time generally is required if the climate is warm and humid and the vegetation is luxuriant. If other factors are equal, less time is also required if the parent material is loamy than if it is clayey.

In terms of geological time, most of the soils in Garland County are old regardless of whether they are on mountaintops, mountainsides, or stream terraces. The younger soils formed in either alluvium along streams or in residuum where geologic erosion has nearly kept pace with weathering of the bedrock.

The soils on the uplands in the county are formed in material weathered from rocks of Ordovician or Pennsylvanian age. Most of the cations have been leached out. The reaction is strongly acid or very strongly acid. There has been considerable weathering and translocation of clay, and the argillic horizon is clearly expressed. Iron, as well as clay, has translocated from the A and E horizons to the B horizon and then oxidized, causing the B horizon to have stronger red, brown, and yellow colors than the A horizon. Carnasaw, Pirum, Sherless, Yanush, and Bigfork soils clearly show the impact of time acting with other soil-forming factors on parent material.

Ceda soils on the narrow flood plains of upland drainageways are younger soils formed in sediments washed from local uplands.

On the stream terraces in the valleys, the Spadra, Avilla, Bonnerdale, and Mazarn soils have been in place long enough for translocation of clay and formation of an argillic horizon.

Processes of Soil Horizon Differentiation

The effects of the soil-forming factors are reflected in the soil profile, which is a succession of layers, or horizons, from the surface downward and includes at least the upper part of the parent material. The parent material has been little altered by soil-forming processes. The horizons differ in one or more properties, such as color, texture, structure, consistence, porosity, or reaction.

Most soil profiles in Garland County contain three to five master horizons or layers. The master layers or horizons are designated A, E, B, C, and R. Young soils generally do not have E and B horizons.

The horizon of maximum accumulation of humified organic matter is called the A horizon or the surface layer. The horizon of maximum leaching of dissolved or suspended materials is called the E horizon or the subsurface layer.

The B horizon lies immediately below the E horizon and is sometimes called the subsoil *(11)*. It is the horizon of maximum accumulation of dissolved or suspended materials, such as iron and silicate clay. Generally, the B horizon has blocky structure and is firmer than the horizons immediately above or below it.

The C horizon or layer lies below the B horizon. Typically, it has been little affected by the soil-forming processes, though it is in some places materially modified by weathering. In some young soils, the C horizon has been only slightly modified by living organisms and by weathering. It is immediately below the A horizon.

The R layer generally lies below the C horizon or layer, but it may lie immediately below an A horizon or B horizon. It is bedrock that is sufficiently coherent when moist to make hand digging with a spade impractical.

The physical weathering of rocks, through heating and cooling and wetting and drying, slowly breaks them into small pieces that form the parent material for the residual soils. This is most evident in the Clebit soils.

In Garland County, several processes have been active in the formation of soil horizons. Among these processes are the accumulation of organic matter, the leaching of carbonates and bases, the oxidation or reduction and transfer of iron, and the formation and translocation of silicate clay minerals. In most of the soils, more than one of these processes were involved.

The accumulation of organic matter in the upper part of the profile (A horizon) is readily evident in the undisturbed areas of the Carnasaw series. These soils have a light color subsurface layer from which organic matter, clay, and iron oxides have been removed.

Leaching of carbonates and bases has occurred in nearly all of the soils in the county. Generally, bases are leached downward in soils before silicate clay minerals begin to move. Most of the soils on uplands have been strongly leached.

Oxidation of iron is evident in moderately well drained and well drained soils, for example, in Sherless, Carnasaw, and Pirum soils on uplands and in Spadra and Avilla soils on terraces. Red or brown B horizons is an indication of the oxidation of iron.

The translocation of silicate clay minerals has contributed to horizon development in most of the soils in Garland County. In areas where the soils are or have been cultivated, most of the eluviated E horizon has been destroyed. Where it remains, however, the E horizon has weak granular to blocky or platy structure, has less clay than the lower horizons, and is a lighter color than the rest of the soil. Clay films generally have accumulated in pores and on surfaces of peds in the B horizon. The soils were probably mostly leached of carbonates and soluble salts before the translocation of silicate clay occurred.

In Garland County, leaching of bases and translocation of silicate clay are among the most important processes of horizon differentiation in the soils.

Geology

Charles G. Stone, geologist, Arkansas Geological Commission, helped prepare this section.

Most of the soils in Garland County formed in material of weathered, consolidated bedrock of the Ordovician through Pennsylvanian periods of the Paleozoic era (see the general geology map immediately following the tables).

All the rocks in the area are of sedimentary origin with the exception of the potash sulfur springs igneous pluton and numerous small dikes. The sedimentary rocks were deposited as nearly flat layers of mud, sand, gravel, marl, lime, volcanic ash, and silica in the marine waters of an ancient deep basin that occupied the region. With the load and weight of the overlying sediments, they were subsequently converted to shale, sandstone, conglomerate, limestone, tuff, chert, and novaculite. These rocks were then subjected to intense compressive forces in late Paleozoic time that transported them towards the north causing them to bend and fold and, in many places, to rupture and fault (fig. 7). Ultimately, the region was uplifted, forming an extensive mountain range. This deformation, called the Ouachita orogeny, caused elevated pressures and temperatures that slightly metamorphosed these rocks in places, changing some shale to slate and sandstone to quartzite.

The uplift produced prominent east-west folds and large thrust faults in the strata. Almost without exception, the present landforms are a reflection of the underlying bedrock. The softer, less resistant shale, limestone, and impure sandstone are more susceptible to erosion and form most of the basins, valley floors, and lower hills. The harder, more resistant novaculite, chert, and relatively pure sandstone form the mountains, ridges, and peaks.

Subsequent to the Ouachita orogeny, the region has been eroded and dissected with minor arching and extensional faulting. Some sizeable igneous intrusions, notably early in Late Cretaceous time, occur in the southeastern part of the county.

During Pliestocene and recent times (Quaternary), the older rocks in the area were further eroded. Terrace, alluvial, and colluvial deposits represent some of the products of these climatically related cycles.

The Collier Shale is the oldest formation exposed in the Ouachita Mountains of Arkansas. The formation is Late Cambrian and Early Ordovician in age. It is of minor extent and is exposed in western Garland County near

Figure 7.—The separation of individual soils is difficult in areas of interbedded sandstone and shale which have been tilted, faulted, and folded.

Crystal Springs. It consists of graphitic to "talcose" shale with considerable amounts of interbedded, dense to very fine-grained, sandy, sometimes pellatoidal, or conglomeratic, bluish gray limestone. There are minor quantities of bluish black chert, gray calcareous siltstone, fine-grained quartzose sandstone, conglomerate, and boulder-bearing breccia. The formation typically forms narrow valleys between the tall ridges formed by the Crystal Mountain Sandstone. Bismarck and Carnasaw soils formed in the weathered shale.

The Crystal Mountain Sandstone is of Early Ordovician age. It is of minor extent and is only exposed in western Garland County near Crystal Springs. The formation is made up of very massive to thin bedded quartzose, calcareous, occasionally conglomeratic, light gray to brown, medium-grained sandstones. Interbedded black, gray to buff shales are common in the upper part of the formation. The massive sandstone interval is quite resistant and forms the tall ridges and peaks in the Crystal Mountains. Pirum and Clebit soils formed in the weathered sandstone, and Carnasaw soils formed in the weathered shale.

The Mazarn Shale is of Ordovician age and outcrops across the central part of Garland County. It consists mostly of black shale with some interbedded olive green shale and silty shale, thinly laminated gray siltstone, brown sandstone and dense blue gray limestone. The alternating black and olive green shale layers, often with crosscutting cleavage, give it a banded appearance. The Mazarn shale typically forms fairly broad valleys with some noticeable low ridges between mountains formed from the Crystal Mountain Sandstone and Blakely Sandstone. Bismarck and Carnasaw soils formed from the weathered shale.

The Blakely Sandstone is of Ordovician age and outcrops across the central part of Garland County. It consists of interbedded thin to fairly massive, fine to medium-grained, sometimes silty or calcareous, occasionally conglomeratic, quartzose brownish gray sandstones and black to green shales. The Blakely Sandstone forms high ridges with small, narrow intervening valleys adjacent to the broad valleys of the Mazarn Shale. Pirum and Clebit soils formed in the weathered sandstone, and Carnasaw soils formed in the weathered shale.

The Womble Shale outcrops in roughly two bands across Garland County, one band to the north of the Blakely Sandstone and Mazarn Shale and one to the south. It is of Ordovician age and consists mostly of black shale with intervals of dense, bluish gray limestone and calcareous siltstone. Minor amounts of gray chert, fine-grained quartzose sandstone and conglomerate are also present. The Womble Shale characteristically forms low, fairly broad valleys with minor east-west trending, rather irregular hills. Bismarck and Carnasaw soils formed in the weathered shales.

The Bigfork Chert is of Ordovician age. It is composed mainly of thin bedded, highly fractured, gray chert, dense gray limestone, calcareous siltstone, and some interbedded black shale (fig. 8). Irregularly shaped "potato" hills are produced by the weathering of the Bigfork Chert. Intense fracturing creates good aquifer conditions in the formation. Because of its finely broken nature, the Bigfork Chert has considerable potential for local supplies of rock aggregate. Avant soils formed in the weathered chert, and Yanush soils formed in colluvial material from the chert on side slopes.

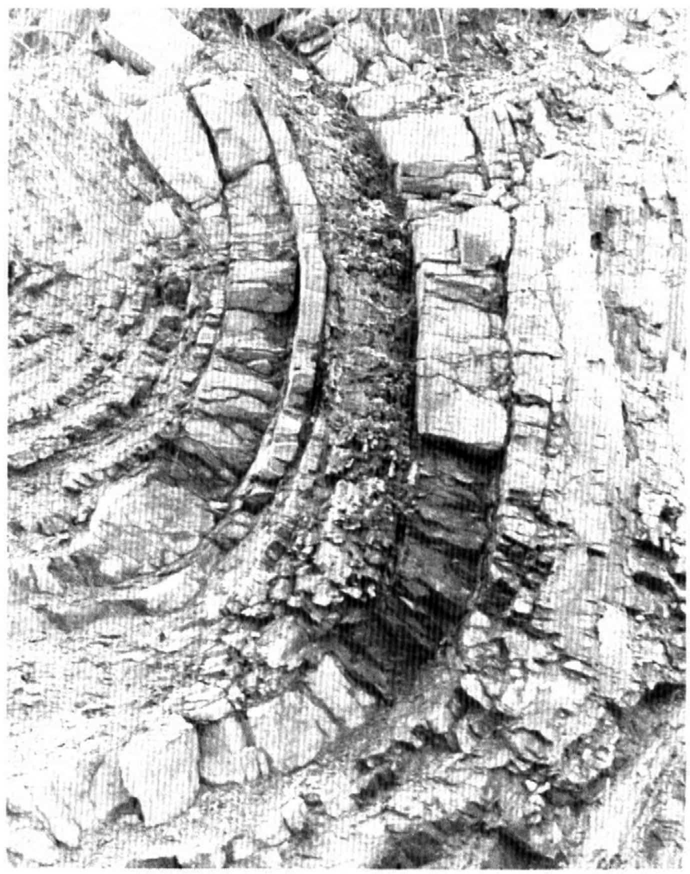


Figure 8.—This section of thin bedded, tilted, and folded material is in a Bigfork Chert formation.

The Polk Creek Shale is late Ordovician in age. It is a black spotty shale, with some very thin gray chert and a few thin blue gray limestone intervals. It is mostly exposed in narrow strips in valleys adjacent to the

Bigfork Chert. Soils similar to the Avant and Yanush soils formed in residuum of this material.

The Missouri Mountain Shale is of Silurian age and lies between the Arkansas novaculite and the Polk Creek Shale. It is typically a red, green, or buff shale or slate with minor novaculite and sandy conglomerate layers. It is generally poorly exposed and forms narrow valleys or slopes. Carnasaw soils formed in the weathered shale.

The Arkansas Novaculite lies adjacent to the Bigfork Chert with the Polk Creek Shale and Missouri Mountain Shale lying between them. These units form three bands across Garland County. The most pronounced band lies across the south-central part of the county and is known as the Zig-Zag Mountains. The second most pronounced band lies across the southern edge of the county and is known as the Trap Mountains. The third and less pronounced band lies across the northern part of the county. The Arkansas Novaculite is Devonian-Mississippian in age and consists predominantly of white to light gray novaculite with lesser amounts of gray chert, olive green to black shale, conglomerate, and sandstone. Novaculite is a hard, dense rock made up essentially of silica, usually white to light gray and resembling unglazed porcelain in general appearance and texture. The Arkansas Novaculite is extremely resistant and forms high, sharp-crested ridges along east-west belts. Novaculite is probably best known as a raw material for making whetstones. Bigfork soils formed in weathered novaculite. Yanush soils formed in the colluvial material from the novaculite, and Carnasaw soils formed in weathered shale.

The Stanley Shale outcrops in the Mazarn basin in the southern part of Garland County and in the valleys in the northernmost part of the county. It is Mississippian in age and is composed mostly of black to brownish green shale with lesser quantities of thin to massive, fine-grained, feldspathic gray to brown sandstone. Minor conglomerate and quartzose sandstone (Hot Spring Sandstone Member) are present in the lower part. The sandstones decompose upon weathering and form rather low ridges. Thus, the Stanley Shale typically forms valleys with a series of low hills. Bismarck and Carnasaw soils formed in material that weathered from shale, and Sherless, Pirum, and Clebit soils formed in material that weathered from sandstone.

The Jackfork Sandstone outcrops across the northern part of the county and in a small band in the southwest corner of the county. It is Pennsylvanian in age and is made up of thin to massive, light brown, fine-grained, quartzitic gray sandstone, blue-black to brown siltstone and interbedded gray-black shale. The massive sandstones are fairly resistant to weathering and typically form ridges with many rock exposures. Pirum and Clebit soils formed in material that weathered from sandstone, and Carnasaw soils formed in material weathered from shale.

Igneous rocks are in several places, mostly in the southeastern part of Garland County. The largest of these is known as the Potash Sulfur Springs intrusive. It is a circular igneous complex, exposed in an area somewhat less than a mile in diameter. It was emplaced early in Late Cretaceous time. The complex has a crude ring structure. The outer ring of the complex is alkali syenite and fenite. Much of the central part of the complex is nepheline syenite. Saprolite, highly weathered rock averaging about 40 feet in thickness, is developed over much of the igneous area, but the outer part of the nepheline syenite ring supports a low ridge. Magnet soils formed in material weathered from the saprolite.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but that have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels, i.e., clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). The volume of soft soil decreases excessively under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazingland for a prescribed period.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic)—Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated)—Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, such as fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Excess fines (in tables). Excess silt and clay are in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The movement of water into the soil is rapid.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant that is not a grass or a sedge.

Fragile (in tables). The soil is easily damaged by use or disturbance.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

Green-manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hardpan. A hardened or cemented soil horizon, or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is, in part, a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as accumulation of clay, sesquioxides, humus, or a combination of these; prismatic or blocky structure; redder or browner colors than those in the A horizon; or a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Arabic numeral 2 precedes the letter C.

R layer.—Consolidated rock (unweathered bedrock) beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the plants that are the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material. This contrasts with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate
1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments that are 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Open space. A relatively undeveloped green or wooded area provided mainly within an urban area to minimize feelings of congested living.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. The quality of the soil that enables water to move through the profile. Permeability is measured as the number of inches per hour that water moves through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Subsurface tunnels or pipelike cavities are formed by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poor outlets (in tables). In these areas, surface or subsurface drainage outlets are difficult or expensive to install.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of the acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rill. A steep sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Rippable bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). There is a shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silica-sesquioxide ratio. The ratio of the number of molecules of silica to the number of molecules of alumina and iron oxide. The more highly weathered soils or their clay fractions in warm-temperate, humid regions, and especially those in the tropics, generally have a low ratio.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Site index. A designation of the quality of a forest site based on the height of the dominant stand at an arbitrarily chosen age. For example, if the average height attained by dominant and codominant trees in a fully stocked stand at the age of 50 years is 75 feet, the site index is 75 feet.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slippage (in tables). The soil mass is susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, thickness of the line can be one fragment or more. It generally overlies material that weathered in place, and it is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in organic matter content than the overlying surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed on the contour or at a slight angle to the contour across sloping soils. The terrace intercepts surface runoff, so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). An therwise suitable soil material that is too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). An excessive amount of toxic substances in the soil, such as sodium or sulfur, severely hinders the establishment of vegetation or severely restricts plant growth.

Trace elements. Chemical elements, such as zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Unstable fill (in tables). There is a risk of caving or sloughing on banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variegation. Refers to patterns of contrasting colors that are assumed to be inherited from the parent material rather than to be the result of poor drainage.

Weathering. All physical and chemical changes produced by atmospheric agents in rocks or other deposits at or near the earth's surface. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. This contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Data recorded in the period 1951-81 at Hot Springs, Arkansas]

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	51.6	31.4	41.5	75	8	52	3.72	1.77	5.40	6	2.0
February---	56.7	34.3	45.5	78	13	71	4.09	1.96	5.92	6	0.6
March------	64.8	41.5	53.2	86	21	191	5.21	2.99	7.18	8	0.3
April------	75.4	51.8	63.6	89	33	408	5.78	2.63	8.47	7	0.0
May--------	81.9	59.2	70.6	94	41	639	6.43	2.92	9.43	7	0.0
June-------	89.1	67.1	78.1	100	53	843	4.46	1.74	6.73	6	0.0
July-------	93.3	71.1	82.2	104	59	998	5.21	2.57	7.49	7	0.0
August-----	92.9	69.6	81.3	103	57	970	3.31	1.35	4.96	5	0.0
September--	86.4	63.3	74.9	100	46	747	4.38	2.11	6.34	6	0.0
October----	76.9	52.8	64.9	93	34	462	3.46	1.04	5.42	5	0.0
November---	63.3	42.0	52.7	82	21	147	4.68	2.14	6.86	6	0.2
December---	54.4	34.6	44.5	75	12	38	4.35	2.18	6.24	6	0.6
Yearly:											
Average--	73.9	51.6	62.8	---	---	---	---	---	---	---	---
Extreme--	---	---	---	106	6	---	---	---	---	---	---
Total----	---	---	---	---	---	5,566	55.08	46.35	63.19	75	3.7

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 °F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Data recorded in the period 1951-81
at Hot Springs, Arkansas]

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	March 21	March 31	April 5
2 years in 10 later than--	March 13	March 23	March 31
5 years in 10 later than--	February 27	March 8	March 21
First freezing temperature in fall:			
1 year in 10 earlier than--	November 10	November 3	October 23
2 years in 10 earlier than--	November 19	November 10	October 29
5 years in 10 earlier than--	December 6	November 24	November 8

TABLE 3.--GROWING SEASON

[Data recorded in the period 1951-81
at Hot Springs, Arkansas]

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	Days	Days	Days
9 years in 10	248	228	208
8 years in 10	259	239	216
5 years in 10	281	260	231
2 years in 10	302	281	246
1 year in 10	314	291	254

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Avant very gravelly silt loam, 3 to 15 percent slopes	5,064	1.1
2	Avilla silt loam, 1 to 3 percent slopes	1,969	0.4
3	Avilla silt loam, 3 to 8 percent slopes	3,030	0.6
4	Bigfork-Rock outcrop complex, 3 to 15 percent slopes	3,507	0.7
5	Bigfork-Rock outcrop complex, 35 to 60 percent slopes	6,356	1.4
6	Bigfork-Yanush-Carnasaw complex, 20 to 40 percent slopes	3,733	0.8
7	Bigfork-Yanush-Carnasaw complex, 40 to 60 percent slopes	7,932	1.7
8	Bismarck-Carnasaw complex, 3 to 8 percent slopes	8,634	1.8
9	Bismarck-Carnasaw complex, 8 to 20 percent slopes	36,691	7.8
10	Bismarck-Carnasaw complex, 20 to 40 percent slopes	59,869	12.7
11	Bismarck-Clebit complex, 40 to 60 percent slopes	1,457	0.3
12	Bismarck-Clebit-Sherless complex, 3 to 8 percent slopes	10,314	2.2
13	Bismarck-Sherless-Clebit complex, 8 to 12 percent slopes	13,637	2.9
14	Bismarck-Sherless-Clebit complex, 12 to 30 percent slopes	28,154	6.0
15	Bonnerdale fine sandy loam, occasionally flooded	9,963	2.1
16	Carnasaw gravelly silt loam, 3 to 8 percent slopes	11,645	2.5
17	Carnasaw gravelly silt loam, 8 to 20 percent slopes	1,199	0.3
18	Carnasaw-Clebit complex, 3 to 15 percent slopes	7,058	1.5
19	Carnasaw-Pirum complex, 3 to 8 percent slopes	3,984	0.8
20	Carnasaw-Pirum complex, 8 to 20 percent slopes	7,881	1.7
21	Carnasaw-Pirum-Clebit complex, 20 to 40 percent slopes	49,698	10.6
22	Carnasaw-Pirum-Clebit complex, 40 to 60 percent slopes	2,130	0.5
23	Ceda gravelly loam, frequently flooded	24,093	5.1
24	Clebit-Pirum-Rock outcrop complex, 3 to 15 percent slopes	2,708	0.6
25	Leadvale silt loam, 1 to 3 percent slopes	1,267	0.3
26	Magnet loam, 15 to 40 percent slopes	305	0.1
27	Mazarn silt loam, occasionally flooded	8,078	1.7
28	Pirum-Clebit-Carnasaw complex, 8 to 20 percent slopes	3,011	0.6
29	Pirum-Clebit-Carnasaw complex, 20 to 40 percent slopes	11,685	2.5
30	Pirum-Clebit-Carnasaw complex, 40 to 60 percent slopes	17,207	3.6
31	Pits-Udorthents complex	340	0.1
32	Sherless-Clebit complex, 3 to 8 percent slopes	9,648	2.1
33	Sherless-Clebit complex, 8 to 12 percent slopes	2,235	0.5
34	Sherless-Clebit complex, 12 to 30 percent slopes	7,133	1.5
35	Spadra loam, occasionally flooded	6,897	1.5
36	Udorthents	840	0.2
37	Yanush very gravelly silt loam, 3 to 12 percent slopes	3,022	0.6
38	Yanush-Avant complex, 20 to 40 percent slopes	8,762	1.9
39	Yanush-Avant complex, 40 to 60 percent slopes	29,286	6.2
	Water*	49,601	10.5
	Total	470,023	100.0

* Enclosed areas of water more than 40 acres in size. Streams or canals more than one-eighth of a statute mile in width.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Map symbol and soil name	Land capability	Common bermudagrass	Improved bermudagrass	Tall fescue	Bahiagrass
		AUM*	AUM*	AUM*	AUM*
1---------- Avant	VIs	3.0	4.0	3.0	4.0
2---------- Avilla	IIe	7.0	8.5	6.5	7.5
3---------- Avilla	IIIe	7.0	8.5	6.5	7.5
4:					
Bigfork----------	VIs	---	---	---	---
Rock outcrop----------	VIIIs	---	---	---	---
5:					
Bigfork----------	VIIs	---	---	---	---
Rock outcrop----------	VIIIs	---	---	---	---
6, 7---------- Bigfork-Yanush-Carnasaw	VIIs	---	---	---	---
8---------- Bismarck-Carnasaw	VIe	4.0	4.5	4.0	4.0
9---------- Bismarck-Carnasaw	VIe	3.5	4.0	3.5	3.5
10---------- Bismarck-Carnasaw	VIIe	---	---	---	---
11---------- Bismarck-Clebit	VIIs	---	---	---	---
12---------- Bismarck-Clebit-Sherless	VIe	3.5	4.0	3.5	3.5
13---------- Bismarck-Sherless-Clebit	VIe	3.5	4.0	3.5	3.5
14---------- Bismarck-Sherless-Clebit	VIIe	---	---	---	---
15---------- Bonnerdale	IIIw	6.0	7.0	5.0	6.0
16---------- Carnasaw	IVe	5.0	6.0	5.0	5.5
17---------- Carnasaw	VIe	4.0	5.0	4.5	5.0
18---------- Carnasaw-Clebit	VIIs	---	---	---	---
19---------- Carnasaw-Pirum	IVe	5.0	6.0	5.0	5.5

See footnote at end of table.

TABLE 5.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Map symbol and soil name	Land capability	Common bermudagrass	Improved bermudagrass	Tall fescue	Bahiagrass
		AUM*	AUM*	AUM*	AUM*
20 Carnasaw-Pirum	VIe	4.0	5.0	4.5	5.0
21, 22 Carnasaw-Pirum-Clebit	VIIs	---	---	---	---
23 Ceda	VIIs	---	---	---	---
24:					
Clebit	VIIs	---	---	---	---
Pirum	VIIs	---	---	---	---
Rock outcrop	VIIIs	---	---	---	---
25 Leadvale	IIe	7.0	8.0	6.5	7.0
26 Magnet	VIIe	---	---	---	---
27 Mazarn	IIIw	6.0	7.0	5.0	6.0
28, 29, 30 Pirum-Clebit-Carnasaw	VIIs	---	---	---	---
31. Pits-Udorthents					
32 Sherless-Clebit	IVe	4.0	5.0	4.5	4.0
33 Sherless-Clebit	VIe	3.5	4.0	3.5	3.5
34 Sherless-Clebit	VIIe	---	---	---	---
35 Spadra	IIw	7.0	8.0	7.0	7.0
36. Udorthents					
37 Yanush	IVe	4.0	5.0	4.0	4.0
38, 39 Yanush-Avant	VIIe	---	---	---	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Map symbol and soil name	Woodland suitability group	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Productivity class*
1 Avant	6F8	Slight	Moderate	Moderate	Moderate	Moderate	Shortleaf pine	60	6
							Southern red oak	---	---
							Post oak	---	---
							Blackjack oak	---	---
							White oak	---	---
							Hickory	---	---
2, 3 Avilla	7A7	Slight	Slight	Slight	Slight	Moderate	Shortleaf pine	65	7
							Southern red oak	65	---
							Loblolly pine	70	---
							Cherrybark oak	---	---
							Sweetgum	70	---
4: Bigfork	4X8	Slight	Moderate	Moderate	Moderate	Moderate	Shortleaf pine	45	4
							Post oak	---	---
							Blackjack oak	---	---
Rock outcrop.									
5: Bigfork	4R9	Moderate	Severe	Moderate	Moderate	Moderate	Shortleaf pine	45	4
							Post oak	---	---
							Blackjack oak	---	---
Rock outcrop.									
6: Bigfork	4R8	Moderate	Moderate	Moderate	Moderate	Moderate	Shortleaf pine	45	4
							Post oak	---	---
							Blackjack oak	---	---
Yanush	7R8	Moderate	Moderate	Moderate	Moderate	Moderate	Shortleaf pine	65	7
							Southern red oak	---	---
Carnasaw	8R8	Moderate	Moderate	Slight	Slight	Moderate	Shortleaf pine	70	8
							Loblolly pine	80	8
7: Bigfork	4R9	Severe	Severe	Moderate	Moderate	Moderate	Shortleaf pine	45	4
							Post oak	---	---
							Blackjack oak	---	---
Yanush	6R9	Severe	Severe	Moderate	Moderate	Moderate	Shortleaf pine	60	6
							Southern red oak	---	---
Carnasaw	7R9	Severe	Severe	Slight	Slight	Moderate	Shortleaf pine	65	7
							Loblolly pine	70	6

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Map symbol and soil name	Wood- land suita- bility group	Management concerns					Potential productivity		
		Erosion hazard	Equip- ment limita- tion	Seedling mortal- ity	Wind- throw hazard	Plant competi- tion	Common trees	Site index	Produc- tivity class*
8, 9:									
Bismarck	4D8	Slight	Slight	Moderate	Severe	Moderate	Shortleaf pine	45	4
							Loblolly pine	50	5
							Eastern redcedar	30	---
							Post oak	---	---
							Blackjack oak	---	---
Carnasaw	8A7	Slight	Slight	Slight	Slight	Moderate	Shortleaf pine	70	8
							Loblolly pine	80	8
10:									
Bismarck	4D8	Moderate	Moderate	Moderate	Severe	Moderate	Shortleaf pine	45	4
							Loblolly pine	50	5
							Eastern redcedar	30	---
							Post oak	---	---
							Blackjack oak	---	---
Carnasaw	8R8	Moderate	Moderate	Slight	Slight	Moderate	Shortleaf pine	70	8
							Loblolly pine	80	8
11:									
Bismarck	4R9	Severe	Severe	Severe	Severe	Moderate	Shortleaf pine	45	4
							Loblolly pine	50	5
							Eastern redcedar	30	---
							Post oak	---	---
							Blackjack oak	---	---
Clebit	3R9	Severe	Severe	Severe	Severe	Slight	Shortleaf pine	40	3
							Eastern redcedar	30	---
							Post oak	---	---
							Blackjack oak	---	---
12:									
Bismarck	4D8	Slight	Slight	Moderate	Severe	Moderate	Shortleaf pine	45	4
							Loblolly pine	50	5
							Eastern redcedar	30	---
							Post oak	---	---
							Blackjack oak	---	---
Clebit	3D9	Slight	Slight	Severe	Severe	Slight	Shortleaf pine	40	3
							Eastern redcedar	30	---
							Post oak	---	---
							Blackjack oak	---	---
							Winged elm	---	---
Sherless	8A7	Slight	Slight	Slight	Slight	Moderate	Shortleaf pine	70	8
							White oak	---	---
							Southern red oak	---	---
							Sweetgum	---	---

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Map symbol and soil name	Woodland suitability group	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Management concerns: Plant competition	Potential productivity: Common trees	Potential productivity: Site index	Potential productivity: Productivity class*
13:									
Bismarck----------	4D8	Slight	Slight	Moderate	Severe	Moderate	Shortleaf pine------	45	4
							Loblolly pine-------	50	5
							Eastern redcedar----	30	---
							Post oak-----------	---	---
							Blackjack oak-------	---	---
Sherless----------	8A7	Slight	Slight	Slight	Slight	Moderate	Shortleaf pine------	70	8
							White oak-----------	---	---
							Southern red oak----	---	---
							Sweetgum-----------	---	---
Clebit------------	3D9	Slight	Slight	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak-----------	---	---
							Blackjack oak-------	---	---
14:									
Bismarck----------	4D8	Moderate	Moderate	Moderate	Severe	Moderate	Shortleaf pine------	45	4
							Loblolly pine-------	50	5
							Eastern redcedar----	30	---
							Post oak-----------	---	---
							Blackjack oak-------	---	---
Sherless----------	8R8	Moderate	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							White oak-----------	---	---
							Southern red oak----	---	---
							Sweetgum-----------	---	---
Clebit------------	3D9	Slight	Moderate	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak-----------	---	---
							Blackjack oak-------	---	---
15----------------- Bonnerdale	8W8	Slight	Moderate	Moderate	Slight	Moderate	Loblolly pine-------	80	8
							Shortleaf pine------	70	8
							Sweetgum-----------	---	---
16, 17------------- Carnasaw	8A7	Slight	Slight	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
18:									
Carnasaw----------	8X8	Slight	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
Clebit------------	3X9	Slight	Moderate	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak-----------	---	---
							Blackjack oak-------	---	---
19:									
Carnasaw----------	8X8	Slight	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
Pirum-------------	8X8	Slight	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
							Southern red oak----	70	---
							White oak-----------	70	---

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Map symbol and soil name	Woodland suitability group	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class*
20:									
Carnasaw----------	8X8	Slight	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
Pirum-------------	8X8	Slight	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
							Southern red oak----	70	---
							White oak-----------	70	---
21:									
Carnasaw----------	8X8	Moderate	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
Pirum-------------	8X8	Moderate	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
							Southern red oak----	70	---
							White oak-----------	70	---
Clebit------------	3X9	Moderate	Moderate	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
22:									
Carnasaw----------	7R9	Severe	Severe	Slight	Slight	Moderate	Shortleaf pine------	65	7
							Loblolly pine-------	70	6
Pirum-------------	8R9	Severe	Severe	Slight	Slight	Moderate	Loblolly pine-------	80	8
							Shortleaf pine------	70	8
							Southern red oak----	70	---
							White oak-----------	70	---
Clebit------------	3R9	Severe	Severe	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
23---------------- Ceda	7F8	Slight	Slight	Moderate	Slight	Moderate	Shortleaf pine------	65	7
							Southern red oak----	---	---
							White oak-----------	---	---
							Sweetgum------------	80	---
							American sycamore---	80	---
24:									
Clebit------------	3X9	Slight	Severe	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
Pirum-------------	8X9	Slight	Severe	Moderate	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
							Southern red oak----	70	---
							White oak-----------	70	---
Rock outcrop.									

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Map symbol and soil name	Woodland suitability group	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class*
25----------------- Leadvale	8A7	Slight	Slight	Slight	Slight	Moderate	Shortleaf pine------	70	8
							White oak-----------	70	---
							Loblolly pine-------	80	8
26----------------- Magnet	8R8	Moderate	Moderate	Moderate	Slight	Moderate	Shortleaf pine------	70	8
							Southern red oak----	60	---
							White oak-----------	60	---
27----------------- Mazarn	7W8	Slight	Moderate	Moderate	Moderate	Moderate	Shortleaf pine------	65	7
							White oak-----------	---	---
							Sweetgum------------	---	---
28:									
Pirum-------------	8X8	Slight	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
							Southern red oak----	70	---
							White oak-----------	70	---
Clebit------------	3X9	Slight	Severe	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
Carnasaw----------	8X8	Slight	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
29:									
Pirum-------------	8X8	Moderate	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
							Southern red oak----	70	---
							White oak-----------	70	---
Clebit------------	3X9	Moderate	Severe	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
Carnasaw----------	8X8	Moderate	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							Loblolly pine-------	80	8
30:									
Pirum-------------	8R9	Severe	Severe	Slight	Slight	Moderate	Loblolly pine-------	80	8
							Shortleaf pine------	70	8
							Southern red oak----	70	---
							White oak-----------	70	---
Clebit------------	3R9	Severe	Severe	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
Carnasaw----------	7R9	Severe	Severe	Slight	Slight	Moderate	Shortleaf pine------	65	7
							Loblolly pine-------	70	6

See footnote at end of table.

TABLE 6.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Map symbol and soil name	Woodland suitability group	Management concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Plant competition	Potential productivity: Common trees	Site index	Productivity class*
32, 33:									
Sherless----------	8A7	Slight	Slight	Slight	Slight	Moderate	Shortleaf pine------	70	8
							White oak-----------	---	---
							Southern red oak----	---	---
							Sweetgum------------	---	---
Clebit-----------	3D9	Slight	Slight	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
34:									
Sherless----------	8R8	Moderate	Moderate	Slight	Slight	Moderate	Shortleaf pine------	70	8
							White oak-----------	---	---
							Southern red oak----	---	---
							Sweetgum------------	---	---
Clebit-----------	3D9	Moderate	Moderate	Severe	Severe	Slight	Shortleaf pine------	40	3
							Eastern redcedar----	30	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
35----------------- Spadra	9A7	Slight	Slight	Slight	Slight	Moderate	Shortleaf pine------	80	9
							Southern red oak----	80	---
							Eastern redcedar----	60	---
37----------------- Yanush	7F8	Slight	Slight	Moderate	Slight	Slight	Shortleaf pine------	65	7
							Southern red oak----	---	---
38:									
Yanush------------	7R8	Moderate	Moderate	Moderate	Moderate	Moderate	Shortleaf pine------	65	7
							Southern red oak----	---	---
Avant-------------	6R8	Moderate	Moderate	Moderate	Moderate	Moderate	Shortleaf pine------	60	6
							Southern red oak----	---	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
							White oak-----------	---	---
							Hickory-------------	---	---
39:									
Yanush------------	7R9	Severe	Severe	Moderate	Moderate	Moderate	Shortleaf pine------	65	7
							Southern red oak----	---	---
Avant-------------	6R9	Severe	Severe	Moderate	Moderate	Moderate	Shortleaf pine------	60	6
							Southern red oak----	---	---
							Post oak------------	---	---
							Blackjack oak-------	---	---
							White oak-----------	---	---
							Hickory-------------	---	---

* Productivity class is the yield in cubic feet per acre per year calculated at the age of culmination of mean annual increment for fully stocked natural stands.

TABLE 7.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
1 Avant	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
2, 3 Avilla	Slight	Slight	Moderate: slope.	Slight.
4:				
Bigfork	Severe: large stones.	Severe: large stones.	Severe: slope, small stones, large stones.	Severe: large stones.
Rock outcrop.				
5:				
Bigfork	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, small stones, large stones.	Severe: large stones, slope.
Rock outcrop.				
6, 7:				
Bigfork	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, small stones, large stones.	Severe: large stones, slope.
Yanush	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
Carnasaw	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
8:				
Bismarck	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Slight.
Carnasaw	Moderate: small stones, percs slowly.	Moderate: small stones, percs slowly.	Severe: small stones.	Slight.
9:				
Bismarck	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Carnasaw	Moderate: slope, small stones, percs slowly.	Moderate: slope, small stones, percs slowly.	Severe: slope, small stones.	Slight.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
10:				
Bismarck	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.
Carnasaw	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Severe: slope.
11:				
Bismarck	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope.
Clebit	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, large stones.	Severe: slope.
12:				
Bismarck	Severe: depth to rock.	Severe: depth to rock.	Severe: small stones, depth to rock.	Slight.
Clebit	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Slight.
Sherless	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
13:				
Bismarck	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
Sherless	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
Clebit	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
14:				
Bismarck	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.
Sherless	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
Clebit	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
15: Bonnerdale	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
16: Carnasaw	Moderate: small stones, percs slowly.	Moderate: small stones, percs slowly.	Severe: small stones.	Slight.
17: Carnasaw	Moderate: slope, small stones, percs slowly.	Moderate: slope, small stones, percs slowly.	Severe: slope, small stones.	Slight.
18:				
Carnasaw	Moderate: slope, percs slowly, small stones.	Moderate: slope, percs slowly, small stones.	Severe: slope, small stones.	Moderate: large stones.
Clebit	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, large stones.	Moderate: large stones.
19:				
Carnasaw	Moderate: small stones, percs slowly.	Moderate: small stones, percs slowly.	Severe: small stones, large stones.	Moderate: large stones.
Pirum	Moderate: small stones.	Moderate: small stones.	Severe: large stones, small stones.	Moderate: large stones.
20:				
Carnasaw	Moderate: slope, small stones, percs slowly.	Moderate: slope, small stones, percs slowly.	Severe: slope, small stones.	Slight.
Pirum	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Moderate: large stones.
21, 22:				
Carnasaw	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.
Pirum	Severe: slope.	Severe: slope.	Severe: slope, large stones.	Severe: slope.
Clebit	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, large stones.	Severe: slope.
23: Ceda	Severe: flooding, small stones.	Severe: small stones.	Severe: flooding, small stones.	Moderate: flooding.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
24:				
Clebit	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, large stones.	Moderate: large stones.
Pirum	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope, large stones.	Moderate: large stones.
Rock outcrop.				
25 Leadvale	Moderate: wetness.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Moderate: wetness.
26 Magnet	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, erodes easily.
27 Mazarn	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.
28:				
Pirum	Moderate: slope, large stones.	Moderate: slope, large stones.	Severe: slope.	Moderate: large stones.
Clebit	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, large stones.	Moderate: large stones.
Carnasaw	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Moderate: large stones.
29, 30:				
Pirum	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Clebit	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, large stones.	Severe: slope.
Carnasaw	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
31:				
Pits.				
Udorthents.				
32:				
Sherless	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Slight.
Clebit	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Slight.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
33:				
Sherless	Moderate: slope, small stones.	Moderate: slope, small stones.	Severe: slope, small stones.	Slight.
Clebit	Severe: small stones, depth to rock.	Severe: small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Slight.
34:				
Sherless	Severe: slope.	Severe: slope.	Severe: slope, small stones.	Moderate: slope.
Clebit	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones, depth to rock.	Moderate: slope.
35 Spadra	Severe: flooding.	Slight	Moderate: small stones, flooding.	Slight.
36: Udorthents.				
37 Yanush	Severe: small stones.	Severe: small stones.	Severe: slope, small stones.	Severe: small stones.
38:				
Yanush	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
Avant	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
39:				
Yanush	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.
Avant	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.

TABLE 8.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
1 Avant	Poor	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
2, 3 Avilla	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
4, 5:										
Bigfork	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Rock outcrop.										
6, 7:										
Bigfork	Very poor.	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
Yanush	Very poor.	Poor	Good	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Carnasaw	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
8, 9:										
Bismarck	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Carnasaw	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
10:										
Bismarck	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Carnasaw	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
11:										
Bismarck	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
12:										
Bismarck	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Sherless	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.

TABLE 8.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
13:										
Bismarck	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Sherless	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
14:										
Bismarck	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Sherless	Very poor.	Poor	Good	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
15 Bonnerdale	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
16, 17 Carnasaw	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
18:										
Carnasaw	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
19:										
Carnasaw	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Pirum	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
20:										
Carnasaw	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Pirum	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
21, 22:										
Carnasaw	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Pirum	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
23 Ceda	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Fair	Fair	Very poor.

TABLE 8.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
24:										
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
Pirum	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Rock outcrop.										
25 Leadvale	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
26 Magnet	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
27 Mazarn	Fair	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
28:										
Pirum	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.
Carnasaw	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
29, 30:										
Pirum	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Poor	Very poor.	Very poor.
Carnasaw	Very poor.	Poor	Good	Good	Good	Very poor.	Very poor.	Poor	Good	Very poor.
31:										
Pits.										
Udorthents.										
32:										
Sherless	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
33:										
Sherless	Poor	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.

TABLE 8.--WILDLIFE HABITAT--Continued

Map symbol and soil name	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
34:										
Sherless	Very poor.	Poor	Good	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Clebit	Very poor.	Poor	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
35 Spadra	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
36. Udorthents.										
37 Yanush	Fair	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Good	Very poor.
38, 39:										
Yanush	Very poor.	Poor	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
Avant	Very poor.	Very poor.	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.

TABLE 9.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1 Avant	Moderate: depth to rock, large stones, slope.	Moderate: slope, large stones.	Moderate: depth to rock, slope, large stones.	Severe: slope.	Moderate: slope, large stones.
2 Avilla	Slight	Slight	Slight	Slight	Slight.
3 Avilla	Slight	Slight	Slight	Moderate: slope.	Slight.
4:					
Bigfork	Severe: depth to rock.	Moderate; large stones, depth to rock, slope.	Severe: depth to rock.	Severe: slope.	Moderate: large stones, depth to rock, slope.
Rock outcrop.					
5:					
Bigfork	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Rock outcrop.					
6, 7:					
Bigfork	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Yanush	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Carnasaw	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell, low strength.
8:					
Bismarck	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.
Carnasaw	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
9:					
Bismarck	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.
Carnasaw	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
10:					
Bismarck	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Carnasaw	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.
11:					
Bismarck	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Clebit	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
12:					
Bismarck	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.
Clebit	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
Sherless	Moderate: depth to rock.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight.
13:					
Bismarck	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.
Sherless	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
Clebit	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
14:					
Bismarck	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Sherless	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Clebit	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
15 Bonnerdale	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.
16 Carnasaw	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
17----------------- Carnasaw	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.
18:					
Carnasaw---------	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
Clebit-----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
19:					
Carnasaw---------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Pirum------------	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock.
20:					
Carnasaw---------	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.
Pirum------------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.
21, 22:					
Carnasaw---------	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell, low strength.
Pirum------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Clebit-----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
23----------------- Ceda	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
24:					
Clebit-----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Pirum------------	Severe: depth to rock.	Moderate: slope, depth to rock, large stones.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, large stones.
Rock outcrop.					

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
25----------------- Leadvale	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: low strength, wetness.
26----------------- Magnet	Severe: slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell, slope.
27----------------- Mazarn	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, flooding.
28:					
Pirum-------------	Severe: depth to rock.	Moderate: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope.
Clebit------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Carnasaw----------	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength.
29, 30:					
Pirum-------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Clebit------------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
Carnasaw----------	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell, low strength.
31:					
Pits.					
Udorthents.					
32:					
Sherless----------	Moderate: depth to rock.	Slight------------	Moderate: depth to rock.	Moderate: slope.	Slight.
Clebit------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
33:					
Sherless----------	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
Clebit------------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.

TABLE 9.--BUILDING SITE DEVELOPMENT--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
34:					
Sherless---------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Clebit-----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
35---------------- Spadra	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
36: Udorthents.					
37---------------- Yanush	Moderate: large stones, slope.	Moderate: large stones, slope.	Moderate: large stones, slope.	Moderate: slope, large stones.	Moderate: large stones, slope.
38, 39:					
Yanush-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Avant------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

TABLE 10.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1: Avant	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
2, 3: Avilla	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Fair: too clayey.
4: Bigfork	Severe: depth to rock, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock.	Poor: area reclaim, large stones.
Rock outcrop.					
5: Bigfork	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones, slope.
Rock outcrop.					
6, 7: Bigfork	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope, large stones.	Severe: depth to rock, slope.	Poor: area reclaim, large stones, slope.
Yanush	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
Carnasaw	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
8: Bismarck	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Carnasaw	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
9:					
Bismarck-----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Carnasaw-----------	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack.
10:					
Bismarck-----------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Carnasaw-----------	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
11:					
Bismarck-----------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Clebit-------------	Severe: depth to rock, slope.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
12:					
Bismarck-----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Clebit-------------	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones, thin layer.
Sherless-----------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
13:					
Bismarck-----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
Sherless-----------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Clebit-------------	Severe: depth to rock.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones, thin layer.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
14:					
Bismarck	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.
Sherless	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope, thin layer.
Clebit	Severe: depth to rock, slope.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
15 Bonnerdale	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding.	Severe: flooding, depth to rock, wetness.	Severe: flooding, seepage, wetness.	Poor: wetness.
16 Carnasaw	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
17 Carnasaw	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack.
18:					
Carnasaw	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack.
Clebit	Severe: depth to rock.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage, large stones.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones, thin layer.
19:					
Carnasaw	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
Pirum	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
20:					
Carnasaw	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack.
Pirum	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
21, 22:					
Carnasaw	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
Pirum	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Clebit	Severe: depth to rock, slope.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
23 Ceda	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Poor: small stones, seepage.
24:					
Clebit	Severe: depth to rock.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage, large stones.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones, thin layer.
Pirum	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Rock outcrop.					
25 Leadvale	Severe: wetness, percs slowly.	Severe: wetness.	Severe: depth to rock.	Moderate: depth to rock, wetness.	Fair: area reclaim, too clayey.
26 Magnet	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey, slope.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
27 Mazarn	Severe: flooding, depth to rock, wetness.	Severe: depth to rock, flooding, wetness.	Severe: flooding, depth to rock, wetness.	Severe: flooding, depth to rock, wetness.	Poor: area reclaim, wetness.
28:					
Pirum	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Clebit	Severe: depth to rock.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage, large stones.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones, thin layer.
Carnasaw	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack.

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
29, 30:					
Pirum	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Clebit	Severe: depth to rock, slope.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
Carnasaw	Severe: percs slowly, slope.	Severe: slope.	Severe: depth to rock, slope, too clayey.	Severe: slope.	Poor: too clayey, hard to pack, slope.
31:					
Pits.					
Udorthents.					
32:					
Sherless	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Clebit	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones, thin layer.
33:					
Sherless	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, thin layer.
Clebit	Severe: depth to rock.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim, small stones, thin layer.
34:					
Sherless	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope, thin layer.
Clebit	Severe: depth to rock, slope.	Severe: depth to rock, slope, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, small stones, slope.
35 Spadra	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
36:					
Udorthents.					

TABLE 10.--SANITARY FACILITIES--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
37------------------ Yanush	Moderate: percs slowly, large stones.	Severe: slope.	Moderate: too clayey, large stones.	Slight-----------	Poor: small stones.
38, 39:					
Yanush-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: small stones, slope.
Avant--------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, small stones, slope.

TABLE 11.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1: Avant	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
2, 3: Avilla	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, area reclaim.
4:				
Bigfork	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: large stones.
Rock outcrop.				
5:				
Bigfork	Poor: area reclaim, slope.	Improbable: excess fines,	Improbable: excess fines,	Poor: large stones, slope.
Rock outcrop.				
6, 7:				
Bigfork	Poor: area reclaim, slope.	Improbable: excess fines,	Improbable: excess fines,	Poor: large stones, slope.
Yanush	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope, area reclaim, too clayey.
Carnasaw	Poor: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, small stones, area reclaim.
8, 9:				
Bismarck	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Carnasaw	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey.
10:				
Bismarck	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Carnasaw	Poor: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim, slope, too clayey.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
11:				
Bismarck	Poor: area reclaim, slope, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Clebit	Poor: area reclaim, slope, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
12:				
Bismarck	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Clebit	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Sherless	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
13:				
Bismarck	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Sherless	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Clebit	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
14:				
Bismarck	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Sherless	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Clebit	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
15 Bonnerdale	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
16, 17 Carnasaw	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
18:				
Carnasaw	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
Clebit	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, large stones.
19, 20:				
Carnasaw	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
Pirum	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
21, 22:				
Carnasaw	Poor: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, too clayey, area reclaim.
Pirum	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Clebit	Poor: area reclaim, slope, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
23 Ceda	Good	Improbable: small stones.	Probable	Poor: small stones, area reclaim.
24:				
Clebit	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, large stones.
Pirum	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Rock outcrop.				
25 Leadvale	Fair: area reclaim, low strength, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
26 Magnet	Poor: area reclaim, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
27 Mazarn	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: depth to rock, too clayey, small stones.
28:				
Pirum	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Clebit	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, large stones.
Carnasaw	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, area reclaim.
29, 30:				
Pirum	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Clebit	Poor: area reclaim, slope, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Carnasaw	Poor: shrink-swell, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope, too clayey, area reclaim.
31:				
Pits.				
Udorthents.				
32, 33:				
Sherless	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones.
Clebit	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
34:				
Sherless	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Clebit	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
35 Spadra	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.

TABLE 11.--CONSTRUCTION MATERIALS--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
36: Udorthents.				
37 Yanush	Fair: large stones.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
38, 39: Yanush	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope, area reclaim.
Avant	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.

TABLE 12.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition; it does not eliminate the need for onsite investigation]

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
1 Avant	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, large stones.	Deep to water	Slope, droughty.	Slope, depth to rock.	Slope, droughty.
2 Avilla	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
3 Avilla	Moderate: seepage.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
4, 5:						
Bigfork	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Rock outcrop.						
6, 7:						
Bigfork	Severe: slope.	Severe: large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Yanush	Severe: slope.	Moderate: large stones.	Deep to water	Droughty, slope, large stones.	Slope, large stones.	Large stones, slope, droughty.
Carnasaw	Severe: slope.	Moderate: large stones, thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Slope, large stones, erodes easily.	Slope, large stones, erodes easily.
8:						
Bismarck	Severe: depth to rock.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Depth to rock	Droughty, depth to rock.
Carnasaw	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
9, 10:						
Bismarck	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, depth to rock.	Slope, droughty, depth to rock.
Carnasaw	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.

TABLE 12.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
11:						
Bismarck	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, depth to rock.	Slope, droughty, depth to rock.
Clebit	Severe: depth to rock, slope, seepage.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
12:						
Bismarck	Severe: depth to rock.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Depth to rock	Droughty, depth to rock.
Clebit	Severe: depth to rock, seepage.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Depth to rock	Droughty, depth to rock.
Sherless	Moderate: seepage, depth to rock.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Depth to rock.	Depth to rock.
13, 14:						
Bismarck	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, depth to rock.	Slope, droughty, depth to rock.
Sherless	Severe: slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Clebit	Severe: depth to rock, slope, seepage.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, depth to rock.	Depth to rock, slope, droughty.
15 Bonnerdale	Severe: seepage.	Severe: thin layer, wetness.	Flooding	Wetness, percs slowly.	Wetness	Wetness.
16 Carnasaw	Moderate: depth to rock, slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
17 Carnasaw	Moderate: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
18:						
Carnasaw	Moderate: slope.	Moderate: large stones, thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Slope, large stones, erodes easily.	Slope, large stones, erodes easily.
Clebit	Severe: depth to rock, seepage.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.

TABLE 12.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
19:						
Carnasaw	Moderate: depth to rock.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Pirum	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock.	Depth to rock.
20:						
Carnasaw	Moderate: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Pirum	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, large stones, depth to rock.	Slope, depth to rock.
21, 22:						
Carnasaw	Severe: slope.	Moderate: large stones, thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Slope, large stones, erodes easily.	Slope, large stones, erodes easily.
Pirum	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Clebit	Severe: depth to rock, slope, seepage.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
23 Ceda	Severe: seepage.	Severe: seepage.	Deep to water	Flooding, droughty.	Large stones	Droughty, large stones.
24:						
Clebit	Severe: depth to rock, seepage.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Pirum	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Rock outcrop.						
25 Leadvale	Moderate: seepage, depth to rock, slope.	Severe: piping.	Percs slowly, slope.	Wetness, percs slowly, rooting depth.	Erodes easily, wetness.	Erodes easily, rooting depth.
26 Magnet	Severe: slope.	Severe: hard to pack.	Deep to water	Depth to rock, slope, erodes easily.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
27 Mazarn	Moderate: seepage, depth to rock.	Moderate: thin layer, piping.	Depth to rock, flooding.	Wetness, depth to rock, flooding.	Depth to rock, wetness.	Wetness, depth to rock.

TABLE 12.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
28:						
Pirum	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Clebit	Severe: depth to rock, seepage.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Carnasaw	Moderate: slope.	Moderate: large stones, thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Slope, large stones, erodes easily.	Slope, large stones, erodes easily.
29, 30:						
Pirum	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
Clebit	Severe: depth to rock, slope, seepage.	Severe: thin layer, large stones.	Deep to water	Large stones, droughty, depth to rock.	Slope, large stones, depth to rock.	Large stones, slope, droughty.
Carnasaw	Severe: slope.	Moderate: large stones, thin layer, hard to pack.	Deep to water	Percs slowly, slope.	Slope, large stones, erodes easily.	Slope, large stones, erodes easily.
31:						
Pits.						
Udorthents.						
32:						
Sherless	Moderate: seepage, depth to rock.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Depth to rock.	Depth to rock.
Clebit	Severe: depth to rock, seepage.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Depth to rock	Droughty, depth to rock.
33, 34:						
Sherless	Moderate: slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Clebit	Severe: depth to rock, slope, seepage.	Severe: thin layer.	Deep to water	Droughty, depth to rock, slope.	Slope, depth to rock.	Depth to rock, slope, droughty.
35 Spadra	Moderate: seepage.	Severe: piping.	Deep to water	Flooding.	Favorable	Favorable.

TABLE 12.--WATER MANAGEMENT--Continued

Map symbol and soil name	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
36: Udorthents.						
37: Yanush	Moderate: seepage, slope.	Moderate: large stones.	Deep to water	Droughty, slope, large stones.	Large stones	Large stones, droughty.
38, 39: Yanush	Severe: slope.	Moderate: large stones.	Deep to water	Droughty, slope, large stones.	Slope, large stones.	Large stones, slope, droughty.
Avant	Severe: slope.	Moderate: thin layer, large stones.	Deep to water	Slope, large stones, droughty.	Slope, large stones, depth to rock.	Large stones, slope, droughty.

TABLE 13.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated. Some soils may have Unified classifications and USDA textures in addition to those shown. In general, the dominant classifications and textures are shown]

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
1 Avant	0-3	Very gravelly silt loam.	GM, GC, GM-GC	A-2, A-4	0-15	30-55	25-50	20-45	15-40	<25	NP-8
	3-7	Very gravelly silt loam, very gravelly loam, very cobbly silt loam.	GM, GC, GM-GC	A-2, A-4	0-40	30-55	25-50	20-45	15-40	<25	NP-8
	7-17	Very gravelly silt loam, very gravelly loam, very cobbly silt loam.	GM, GC, GM-GC	A-2, A-4	0-40	30-55	25-50	20-45	15-40	20-30	4-10
	17-36	Very gravelly silty clay loam, very cobbly silty clay loam.	GM, GC, GM-GC	A-2, A-4, A-6	0-40	30-55	20-50	20-45	18-40	25-35	6-15
	36-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
2, 3 Avilla	0-10	Silt loam	ML, CL-ML, CL	A-4	0	100	85-100	80-90	60-80	<23	NP-10
	10-42	Loam, clay loam, sandy clay loam.	CL, SC, CL-ML	A-6, A-4	0	100	75-100	80-90	45-80	23-38	7-15
	42-72	Gravelly loam, gravelly clay loam, very gravelly clay loam.	SC, GC, GP-GC, SP-SC	A-2, A-4, A-6	0-10	40-90	25-75	15-60	12-50	23-38	7-15
4, 5: Bigfork	0-9	Stony loam	CL, SM-SC, SC, CL-ML	A-4, A-6	15-50	55-80	55-80	45-75	36-75	22-32	5-15
	9-31	Stony silty clay loam, stony clay loam, very stony clay loam.	CL, SC	A-6, A-7	15-50	55-80	55-80	50-75	44-75	33-43	12-20
	31-35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
6, 7:											
Bigfork---------	0-9	Stony silt loam	CL, SM-SC, SC, CL-ML	A-4, A-6	15-50	55-80	55-80	45-75	36-75	22-32	5-15
	9-31	Stony silty clay loam, stony clay loam, very stony clay loam.	CL, SC	A-6, A-7	15-50	55-80	55-80	50-75	44-75	33-43	12-20
	31-35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Yanush----------	0-5	Stony silt loam	ML, CL, GC, GM	A-4, A-6	20-30	45-75	45-75	40-75	35-70	22-35	2-14
	5-72	Very gravelly clay loam, very gravelly silty clay loam, extremely gravelly silty clay loam.	GC, CL	A-6, A-7, A-2	10-20	20-60	20-60	20-60	15-55	33-43	12-20
Carnasaw--------	0-5	Stony loam-------	CL, SC, SM, ML	A-4, A-6	20-40	85-95	85-95	75-90	40-75	26-37	3-14
	5-11	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	85-95	85-95	75-95	70-95	37-65	18-35
	11-32	Clay, silty clay	CL, CH	A-7	0-10	85-95	85-95	80-95	70-95	41-65	18-35
	32-42	Gravelly silty clay, channery silty clay, clay	CL, CH	A-7	0-10	55-90	55-90	55-90	50-90	41-65	18-35
	42-50	Weathered bedrock	---	---	---	---	---	---	---	---	---
8, 9, 10:											
Bismarck--------	0-3	Gravelly silt loam.	SM, SM-SC, ML, CL-ML	A-4	0-5	55-80	50-75	45-65	40-60	<30	NP-10
	3-16	Extremely channery silt loam, extremely channery loam, very channery silty loam.	GM, GM-GC, SM-SC, SM	A-1, A-2	0-10	25-70	15-50	15-40	12-35	<30	NP-10
	16-22	Weathered bedrock	---	---	---	---	---	---	---	---	---
Carnasaw--------	0-5	Gravelly silt loam.	CL, SC	A-4, A-6	0-10	55-75	55-75	45-75	35-75	30-37	8-14
	5-11	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	85-95	85-95	75-95	70-95	37-65	18-35
	11-32	Clay, silty clay	CL, CH	A-7	0-10	85-95	85-95	80-95	70-95	41-65	18-35
	32-42	Gravelly silty clay, channery silty clay, clay	CL, CH	A-7	0-10	55-90	55-90	55-90	50-90	41-65	18-35
	42-50	Weathered bedrock	---	---	---	---	---	---	---	---	---

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
11:											
Bismarck	0-3	Gravelly silt loam.	SM, SM-SC, ML, CL-ML	A-4	0-5	55-80	50-75	45-65	40-60	<30	NP-10
	3-16	Extremely channery silt loam, extremely channery loam, channery silt loam, very channery silt loam.	GM, GM-GC, SM-SC, SM	A-1, A-2	0-10	25-70	15-50	15-40	12-35	<30	NP-10
	16-22	Weathered bedrock	---	---	---	---	---	---	---	---	---
Clebit	0-6	Stony loam	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	20-45	24-35	4-13
	6-12	Stony loam, stony fine sandy loam.	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	13-45	<35	NP-13
	12-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
12:											
Bismarck	0-3	Gravelly silt loam.	SM, SM-SC, ML, CL-ML	A-4	0-5	55-80	50-75	45-65	40-60	<30	NP-10
	3-16	Extremely channery silt loam, extremely channery loam, very channery silt loam.	GM, GM-GC, SM-SC, SM	A-1, A-2	0-10	25-70	15-50	15-40	12-35	<30	NP-10
	16-22	Weathered bedrock	---	---	---	---	---	---	---	---	---
Clebit	0-6	Very gravelly loam.	GM, GC, GM-GC	A-1, A-2, A-4, A-6	0-15	35-50	35-50	30-50	20-45	24-35	4-13
	6-12	Very gravelly loam, very gravelly fine sandy loam.	GM, GC, GM-GC	A-1, A-2, A-4, A-6	0-15	35-50	35-50	30-50	13-45	<35	NP-13
	12-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sherless	0-11	Gravelly fine sandy loam.	SM, SC, SM-SC	A-2, A-4	0-10	75-90	70-80	65-75	25-49	<26	NP-8
	11-39	Clay loam, sandy clay loam, gravelly sandy clay loam.	CL, SC	A-2, A-4, A-6	0-10	75-95	70-90	45-85	25-80	25-40	8-18
	39-42	Weathered bedrock	---	---	---	---	---	---	---	---	---

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
13, 14:											
Bismarck--------	0-3	Gravelly silt loam.	SM, SM-SC, ML, CL-ML	A-4	0-5	55-80	50-75	45-65	40-60	<30	NP-10
	3-16	Extremely channery silt loam, extremely channery loam, very channery silt loam.	GM, GM-GC, SM-SC, SM	A-1, A-2	0-10	25-70	15-50	15-40	12-35	<30	NP-10
	16-22	Weathered bedrock	---	---	---	---	---	---	---	---	---
Sherless--------	0-11	Gravelly fine sandy loam.	SM, SC, SM-SC	A-2, A-4	0-10	75-90	70-80	65-75	25-49	<26	NP-8
	11-39	Clay loam, sandy clay loam, gravelly sandy clay loam.	CL, SC	A-2, A-4, A-6	0-10	75-95	70-90	45-85	25-80	25-40	8-18
	39-42	Weathered bedrock	---	---	---	---	---	---	---	---	---
Clebit----------	0-6	Very gravelly loam.	GM, GC, GM-GC	A-1, A-2, A-4, A-6	0-15	35-50	35-50	30-50	20-45	24-35	4-13
	6-12	Very gravelly loam, very gravelly fine sandy loam.	GM, GC, GM-GC	A-1, A-2, A-4, A-6	0-15	35-50	35-50	30-50	13-45	<35	NP-13
	12-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
15--------------- Bonnerdale	0-6	Fine sandy loam	SM, ML	A-4	0	90-100	85-100	80-95	45-55	<20	NP-3
	6-17	Fine sandy loam, sandy loam, loam.	SM, SM-SC, ML, CL-ML	A-4	0	90-100	85-100	80-95	45-60	<25	NP-8
	17-50	Fine sandy loam, loam, sandy clay loam.	SC, CL	A-4, A-6	0	90-100	85-100	80-95	45-60	20-35	8-15
	50-54	Clay loam, silty clay, channery clay loam.	CL, CH, SC, GC	A-7	0	70-100	60-100	55-95	40-75	40-60	18-35
	54-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
16, 17----------- Carnasaw	0-5	Gravelly silt loam.	CL, SC	A-4, A-6	0-10	55-75	55-75	45-75	35-75	30-37	8-14
	5-11	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	85-95	85-95	75-95	70-95	37-65	18-35
	11-32	Clay, silty clay	CL, CH	A-7	0-10	85-95	85-95	80-95	70-95	41-65	18-35
	32-42	Gravelly silty clay, channery silty clay, clay	CL, CH	A-7	0-10	55-90	55-90	55-90	50-90	41-65	18-35
	42-50	Weathered bedrock	---	---	---	---	---	---	---	---	---

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
18:											
Carnasaw--------	0-5	Stony loam-------	CL, SC, SM, ML	A-4, A-6	20-40	85-95	85-95	75-90	40-75	26-37	3-14
	5-11	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	85-95	85-95	75-95	70-95	37-65	18-35
	11-32	Clay, silty clay	CL, CH	A-7	0-10	85-95	85-95	80-95	70-95	41-65	18-35
	32-42	Gravelly silty clay, channery silty clay, clay	CL, CH	A-7	0-10	55-90	55-90	55-90	50-90	41-65	18-35
	42-50	Weathered bedrock	---	---	---	---	---	---	---	---	---
Clebit----------	0-6	Stony loam-------	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	20-45	24-35	4-13
	6-12	Stony loam, stony fine sandy loam, bouldery fine sandy loam.	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	13-45	<35	NP-13
	12-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
19, 20:											
Carnasaw--------	0-5	Cobbly loam------	CL, SC	A-4, A-6	15-25	70-85	70-85	60-75	35-75	30-37	8-14
	5-11	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	85-95	85-95	75-95	70-95	37-65	18-35
	11-32	Clay, silty clay	CL, CH	A-7	0-10	85-95	85-95	80-95	70-95	41-65	18-35
	32-42	Gravelly silty clay, channery silty clay, clay	CL, CH	A-7	0-10	55-90	55-90	55-90	50-90	41-65	18-35
	42-50	Weathered bedrock	---	---	---	---	---	---	---	---	---
Pirum-----------	0-4	Cobbly loam------	SM, ML	A-4	15-35	75-100	75-100	70-90	36-65	<20	NP-3
	4-40	Sandy clay loam, clay loam, loam.	CL, CL-ML	A-4, A-6	0-10	75-100	75-100	70-90	50-70	22-35	5-15
	40-50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
21, 22:											
Carnasaw--------	0-5	Stony loam-------	CL, SC, SM, ML	A-4, A-6	20-40	85-95	85-95	75-90	40-75	26-37	3-14
	5-11	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	85-95	85-95	75-95	70-95	37-65	18-35
	11-32	Clay, silty clay	CL, CH	A-7	0-10	85-95	85-95	80-95	70-95	41-65	18-35
	32-42	Gravelly silty clay, channery silty clay, clay	CL, CH	A-7	0-10	55-90	55-90	55-90	50-90	41-65	18-35
	42-50	Weathered bedrock	---	---	---	---	---	---	---	---	---
Pirum-----------	0-4	Stony loam-------	SM, ML	A-4	15-35	75-100	75-100	70-90	36-65	<20	NP-3
	4-40	Sandy clay loam, clay loam, loam.	CL, CL-ML	A-4, A-6	0-10	75-100	75-100	70-90	50-70	22-35	5-15
	40-50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Clebit----------	0-6	Stony loam-------	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	20-45	24-35	4-13
	6-12	Stony loam, stony fine sandy loam,	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	13-45	<35	NP-13
	12-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
23---------------- Ceda	0-6	Gravelly loam----	SM, GM, ML, GM-GC	A-1, A-2, A-4	0-10	50-75	50-75	35-65	20-65	22-29	2-7
	6-72	Very gravelly loam, very gravelly fine sandy loam, cobbly clay loam.	GM, GP-GM, GM-GC	A-1, A-2, A-4, A-6	0-30	15-50	15-50	10-50	5-45	<40	NP-18
24: Clebit----------	0-6	Bouldery loam----	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	20-45	24-35	4-13
	6-12	Stony loam, stony fine sandy loam, bouldery fine sandy loam.	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	13-45	<35	NP-13
	12-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Pirum-----------	0-4	Very stony loam--	SM, ML	A-4	35-50	75-100	75-100	70-90	36-65	<20	NP-3
	4-40	Sandy clay loam, clay loam, loam.	CL, CL-ML	A-4, A-6	0-10	75-100	75-100	70-90	50-70	22-35	5-15
	40-50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
25---------------- Leadvale	0-6	Silt loam--------	ML, CL-ML, CL	A-4	0	100	95-100	85-95	65-85	18-32	2-10
	6-29	Silt loam, silty clay loam, loam.	CL-ML, CL, ML	A-4, A-6	0	100	95-100	90-98	75-90	22-36	3-14
	29-48	Silt loam, silty clay loam.	CL-ML, CL, ML	A-4, A-6, A-7	0	100	95-100	80-98	70-90	23-42	3-18
	48-60	Silty clay loam, silty clay, clay.	CL, MH, ML, CH	A-6, A-7	0-5	90-100	90-100	85-95	70-90	32-58	12-26
26---------------- Magnet	0-6	Loam-------------	CL-ML, CL	A-4	0-5	80-100	75-100	65-85	60-80	<30	5-10
	6-30	Clay loam, gravelly clay loam, cobbly clay loam.	CH, GC, SC	A-7	0-20	60-100	55-100	50-85	45-80	50-70	25-45
	30-72	Weathered bedrock	---	---	---	---	---	---	---	---	---
27---------------- Mazarn	0-4	Silt loam--------	ML, CL, CL-ML	A-4	0	100	95-100	90-95	75-90	18-30	4-10
	4-14	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	90-100	80-90	70-85	24-40	8-20
	14-30	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	95-100	80-100	70-90	65-80	24-40	8-20
	30-36	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	80-100	55-95	50-85	40-75	28-48	10-24
	36-40	Weathered bedrock	---	---	---	---	---	---	---	---	---

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
28, 29, 30:											
Pirum	0-4	Stony loam	SM, ML	A-4	15-35	75-100	75-100	70-90	36-65	<20	NP-3
	4-40	Sandy clay loam, clay loam, loam.	CL, CL-ML	A-4, A-6	0-10	75-100	75-100	70-90	50-70	22-35	5-15
	40-50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Clebit	0-6	Stony loam	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	20-45	24-35	4-13
	6-12	Stony loam, stony fine sandy loam.	GM, GC, GM-GC	A-1, A-2, A-4, A-6	15-40	35-50	35-50	30-50	13-45	<35	NP-13
	12-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Carnasaw	0-5	Stony loam	CL, SC, SM, ML	A-4, A-6	20-40	85-95	85-95	75-90	40-75	26-37	3-14
	5-11	Silty clay loam, clay loam, clay.	CL, CH	A-6, A-7	0-10	85-95	85-95	75-95	70-95	37-65	18-35
	11-32	Clay, silty clay	CL, CH	A-7	0-10	85-95	85-95	80-95	70-95	41-65	18-35
	32-42	Gravelly silty clay, channery silty clay, clay	CL, CH	A-7	0-10	55-90	55-90	55-90	50-90	41-65	18-35
	42-50	Weathered bedrock	---	---	---	---	---	---	---	---	---
31:											
Pits.											
Udorthents.											
32, 33, 34:											
Sherless	0-11	Gravelly fine sandy loam.	SM, SC, SM-SC	A-2, A-4	0-10	75-90	70-80	65-75	25-49	<26	NP-8
	11-39	Clay loam, sandy clay loam, gravelly sandy clay loam.	CL, SC	A-2, A-4, A-6	0-10	75-95	70-90	45-85	25-80	25-40	8-18
	39-42	Weathered bedrock	---	---	---	---	---	---	---	---	---
Clebit	0-6	Very gravelly fine sandy loam.	GM, GM-GC	A-1, A-2	0-15	35-50	35-50	30-50	13-30	<26	NP-7
	6-12	Very gravelly loam, very gravelly fine sandy loam.	GM, GC, GM-GC	A-1, A-2, A-4, A-6	0-15	35-50	35-50	30-50	13-45	<35	NP-13
	12-24	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
35---------------- Spadra	0-3	Loam-------------	ML, SM	A-2, A-4	0	85-100	80-100	65-100	30-75	<20	NP-3
	3-48	Loam, sandy clay loam, clay loam.	CL, CL-ML, ML	A-4, A-6	0	90-100	90-100	80-95	55-75	25-40	NP-15
	48-72	Fine sandy loam, loam, gravelly fine sandy loam.	ML, CL, SM, SC	A-4, A-2,	0	70-100	70-100	40-85	20-65	<30	NP-10
36: Udorthents.											
37---------------- Yanush	0-5	Very gravelly silt loam.	ML, CL, GC, GM	A-4, A-6	10-20	45-75	45-60	40-60	35-55	22-35	2-14
	5-72	Very gravelly clay loam, very gravelly silty clay loam, extremely gravelly silty clay loam.	GC, CL	A-6, A-7, A-2	10-20	20-60	20-60	20-60	15-55	33-43	12-20
38: Yanush----------	0-5	Very gravelly silt loam.	ML, CL, GC, GM	A-4, A-6	10-20	45-75	45-60	40-60	35-55	22-35	2-14
	5-72	Very gravelly clay loam, very gravelly silty clay loam, extremely gravelly silty clay loam.	GC, CL	A-6, A-7, A-2	10-20	20-60	20-60	20-60	15-55	33-43	12-20
Avant-----------	0-3	Very gravelly silt loam.	GM, GC, GM-GC	A-2, A-4	0-15	30-55	25-50	20-45	15-40	<25	NP-8
	3-7	Very gravelly silt loam, very gravelly loam, very cobbly silt loam.	GM, GC, GM-GC	A-2, A-4	0-40	30-55	25-50	20-45	15-40	<25	NP-8
	7-17	Very gravelly silt loam, very gravelly loam, very cobbly silt loam.	GM, GC, GM-GC	A-2, A-4	0-40	30-55	25-50	20-45	15-40	20-30	4-10
	17-36	Very gravelly silty clay loam, very cobbly silty clay loam.	GM, GC, GM-GC	A-2, A-4, A-6	0-40	30-55	20-50	20-45	18-40	25-35	6-15
	36-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 13.--ENGINEERING INDEX PROPERTIES--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
39:											
Yanush----------	0-5	Very gravelly silt loam.	ML, CL, GC, GM	A-4, A-6	10-20	45-75	45-60	40-60	35-55	22-35	2-14
	5-72	Very gravelly clay loam, very gravelly silty clay loam, extremely gravelly silty clay loam.	GC, CL	A-6, A-7, A-2	10-20	20-60	20-60	20-60	15-55	33-43	12-20
Avant-----------	0-3	Very gravelly silt loam.	GM, GC, GM-GC	A-2, A-4	0-15	30-55	25-50	20-45	15-40	<25	NP-8
	3-7	Very gravelly silt loam, very gravelly loam, very cobbly silt loam.	GM, GC, GM-GC	A-2, A-4	0-40	30-55	25-50	20-45	15-40	<25	NP-8
	7-17	Very gravelly silt loam, very gravelly loam, very cobbly silt loam.	GM, GC, GM-GC	A-2, A-4	0-40	30-55	25-50	20-45	15-40	20-30	4-10
	17-36	Very gravelly silty clay loam, very cobbly silty clay loam.	GM, GC, GM-GC	A-2, A-4, A-6	0-40	30-55	20-50	20-45	18-40	25-35	6-15
	36-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH				Pct
1------------------ Avant	0-3	5-20	1.30-1.60	0.6-2.0	0.06-0.16	4.5-6.0	Low-----------	0.24	2	2-4
	3-7	5-20	1.30-1.60	0.6-2.0	0.06-0.16	4.5-6.0	Low-----------	0.24		
	7-17	10-25	1.25-1.55	0.6-2.0	0.06-0.16	4.5-6.0	Low-----------	0.24		
	17-36	15-35	1.20-1.50	0.6-2.0	0.04-0.14	4.5-6.0	Low-----------	0.20		
	36-42	---	---	---	---	---	-------------	----		
2, 3-------------- Avilla	0-10	18-27	1.30-1.50	0.6-2.0	0.10-0.24	4.5-6.5	Low-----------	0.24	4	.5-1
	10-42	20-35	1.25-1.50	0.6-2.0	0.12-0.20	4.5-5.5	Low-----------	0.28		
	42-72	25-40	1.25-1.45	0.6-6.0	0.04-0.15	4.5-5.5	Low-----------	0.24		
4, 5:										
Bigfork----------	0-9	20-26	1.30-1.55	0.6-2.0	0.02-0.16	5.1-6.0	Low-----------	0.32	2	.5-2
	9-31	27-35	1.45-1.70	0.6-2.0	0.02-0.14	4.5-6.0	Low-----------	0.28		
	31-35	---	---	---	---	---	-------------	----		
Rock outcrop.										
6, 7:										
Bigfork----------	0-9	20-26	1.30-1.55	0.6-2.0	0.02-0.16	5.1-6.0	Low-----------	0.32	2	.5-2
	9-31	27-35	1.45-1.70	0.6-2.0	0.02-0.14	4.5-6.0	Low-----------	0.28		
	31-35	---	---	---	---	---	-------------	----		
Yanush-----------	0-5	18-26	1.30-1.55	0.6-2.0	0.08-0.17	5.5-6.0	Low-----------	0.32	5	.5-2
	5-72	27-35	1.45-1.70	0.6-2.0	0.05-0.11	4.5-5.5	Low-----------	0.28		
Carnasaw---------	0-5	15-26	1.30-1.60	0.6-2.0	0.10-0.20	4.5-5.5	Low-----------	0.24	4	.5-2
	5-11	35-45	1.45-1.70	0.2-0.6	0.12-0.20	4.5-5.5	High----------	0.37		
	11-32	40-60	1.35-1.60	0.06-0.2	0.12-0.18	4.5-5.5	High----------	0.32		
	32-42	40-60	1.35-1.60	0.06-0.2	0.07-0.15	4.5-5.5	High----------	0.32		
	42-50	---	---	---	---	---	-------------	----		
8, 9, 10:										
Bismarck---------	0-3	10-18	1.35-1.55	0.6-2.0	0.11-0.17	4.5-5.5	Low-----------	0.32	1	.5-2
	3-16	12-20	1.30-1.50	0.6-2.0	0.03-0.13	4.5-5.5	Low-----------	0.28		
	16-22	---	---	---	---	---	-------------	----		
Carnasaw---------	0-5	15-26	1.30-1.60	0.6-2.0	0.08-0.20	4.5-5.5	Low-----------	0.32	4	.5-2
	5-11	35-45	1.45-1.70	0.2-0.6	0.12-0.20	4.5-5.5	High----------	0.37		
	11-32	40-65	1.35-1.60	0.06-0.2	0.12-0.18	4.5-5.5	High----------	0.32		
	32-42	40-65	1.35-1.60	0.06-0.2	0.07-0.15	4.5-5.5	High----------	0.32		
	42-50	---	---	---	---	---	-------------	----		
11:										
Bismarck---------	0-3	10-18	1.35-1.55	0.6-2.0	0.11-0.17	4.5-5.5	Low-----------	0.32	1	.5-2
	3-16	12-20	1.30-1.50	0.6-2.0	0.03-0.13	4.5-5.5	Low-----------	0.28		
	16-22	---	---	---	---	---	-------------	----		
Clebit-----------	0-6	10-20	1.30-1.60	2.0-6.0	0.05-0.10	4.5-5.5	Low-----------	0.28	1	.5-1
	6-12	10-20	1.30-1.60	2.0-6.0	0.04-0.10	4.5-5.5	Low-----------	0.28		
	12-24	---	---	---	---	---	-------------	----		

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH				Pct
12:										
Bismarck--------	0-3	10-18	1.35-1.55	0.6-2.0	0.11-0.17	4.5-5.5	Low----------	0.32	1	.5-2
	3-16	12-20	1.30-1.50	0.6-2.0	0.03-0.13	4.5-5.5	Low----------	0.28		
	16-22	---	---	---	---	---	-------------	----		
Clebit----------	0-6	10-20	1.30-1.60	2.0-6.0	0.05-0.10	4.5-5.5	Low----------	0.28	1	.5-1
	6-12	10-20	1.30-1.60	2.0-6.0	0.04-0.10	4.5-5.5	Low----------	0.28		
	12-24	---	---	---	---	---	-------------	----		
Sherless--------	0-11	5-18	1.30-1.60	2.0-6.0	0.08-0.13	4.5-5.5	Low----------	0.20	3	.5-1
	11-39	20-35	1.45-1.70	0.6-2.0	0.09-0.18	4.5-5.5	Low----------	0.28		
	39-42	---	---	---	---	---	-------------	----		
13, 14:										
Bismarck--------	0-3	10-18	1.35-1.55	0.6-2.0	0.11-0.17	4.5-5.5	Low----------	0.32	1	.5-2
	3-16	12-20	1.30-1.50	0.6-2.0	0.03-0.13	4.5-5.5	Low----------	0.28		
	16-22	---	---	---	---	---	-------------	----		
Sherless--------	0-11	5-18	1.30-1.60	2.0-6.0	0.08-0.13	4.5-5.5	Low----------	0.20	3	.5-1
	11-39	20-35	1.45-1.70	0.6-2.0	0.09-0.18	4.5-5.5	Low----------	0.28		
	39-42	---	---	---	---	---	-------------	----		
Clebit----------	0-6	10-20	1.30-1.60	2.0-6.0	0.05-0.10	4.5-5.5	Low----------	0.28	1	.5-1
	6-12	10-20	1.30-1.60	2.0-6.0	0.04-0.10	4.5-5.5	Low----------	0.28		
	12-24	---	---	---	---	---	-------------	----		
15--------------- Bonnerdale	0-6	5-12	1.50-1.60	2.0-6.0	0.11-0.13	4.5-5.5	Low----------	0.28	4	1-4
	6-17	10-18	1.45-1.55	2.0-6.0	0.11-0.18	4.5-5.5	Low----------	0.28		
	17-50	15-30	1.40-1.50	0.6-2.0	0.12-0.18	4.5-5.5	Low----------	0.28		
	50-54	27-40	1.25-1.50	0.06-0.2	0.11-0.18	4.5-5.5	Moderate-----	0.32		
	54-60	---	---	---	---	---	-------------	----		
16, 17----------- Carnasaw	0-5	15-26	1.30-1.60	0.6-2.0	0.08-0.20	4.5-5.5	Low----------	0.32	4	.5-2
	5-11	35-45	1.45-1.70	0.2-0.6	0.12-0.20	4.5-5.5	High---------	0.37		
	11-32	40-65	1.35-1.60	0.06-0.2	0.12-0.18	4.5-5.5	High---------	0.32		
	32-42	40-65	1.35-1.60	0.06-0.2	0.07-0.15	4.5-5.5	High---------	0.32		
	42-50	---	---	---	---	---	-------------	----		
18:										
Carnasaw--------	0-5	15-26	1.30-1.60	0.6-2.0	0.10-0.20	4.5-5.5	Low----------	0.24	4	.5-2
	5-11	35-45	1.45-1.70	0.2-0.6	0.12-0.20	4.5-5.5	High---------	0.37		
	11-32	40-60	1.35-1.60	0.06-0.2	0.12-0.18	4.5-5.5	High---------	0.32		
	32-42	40-60	1.35-1.60	0.06-0.2	0.07-0.15	4.5-5.5	High---------	0.32		
	42-50	---	---	---	---	---	-------------	----		
Clebit----------	0-6	10-20	1.30-1.60	2.0-6.0	0.05-0.10	4.5-5.5	Low----------	0.28	1	.5-1
	6-12	10-20	1.30-1.60	2.0-6.0	0.04-0.10	4.5-5.5	Low----------	0.28		
	12-24	---	---	---	---	---	-------------	----		
19, 20:										
Carnasaw--------	0-5	15-26	1.30-1.60	0.6-2.0	0.08-0.20	4.5-5.5	Low----------	0.32	4	.5-2
	5-11	35-45	1.45-1.70	0.2-0.6	0.12-0.20	4.5-5.5	High---------	0.37		
	11-32	40-65	1.35-1.60	0.06-0.2	0.12-0.18	4.5-5.5	High---------	0.32		
	32-42	40-65	1.35-1.60	0.06-0.2	0.07-0.15	4.5-5.5	High---------	0.32		
	42-50	---	---	---	---	---	-------------	----		
Pirum-----------	0-4	18-27	1.30-1.60	0.6-2.0	0.08-0.12	4.5-5.5	Low----------	0.20	2	.5-2
	4-40	18-35	1.25-1.60	0.6-2.0	0.12-0.16	4.5-5.5	Low----------	0.32		
	40-50	---	---	---	---	---	-------------	----		

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH				Pct
21, 22:										
Carnasaw--------	0-5	15-26	1.30-1.60	0.6-2.0	0.10-0.20	4.5-5.5	Low----------	0.24	4	.5-2
	5-11	35-45	1.45-1.70	0.2-0.6	0.12-0.20	4.5-5.5	High---------	0.37		
	11-32	40-60	1.35-1.60	0.06-0.2	0.12-0.18	4.5-5.5	High---------	0.32		
	32-42	40-60	1.35-1.60	0.06-0.2	0.07-0.15	4.5-5.5	High---------	0.32		
	42-50	---	---	---	---	---	-------------	----		
Pirum----------	0-4	18-27	1.30-1.60	0.6-2.0	0.08-0.12	4.5-5.5	Low----------	0.20	2	.5-2
	4-40	18-35	1.25-1.60	0.6-2.0	0.12-0.16	4.5-5.5	Low----------	0.32		
	40-50	---	---	---	---	---	-------------	----		
Clebit----------	0-6	10-20	1.30-1.60	2.0-6.0	0.05-0.10	4.5-5.5	Low----------	0.28	1	.5-1
	6-12	10-20	1.30-1.60	2.0-6.0	0.04-0.10	4.5-5.5	Low----------	0.28		
	12-24	---	---	---	---	---	-------------	----		
23--------------- Ceda	0-6	10-18	1.30-1.55	6.0-20	0.07-0.17	5.6-6.5	Low----------	0.28	5	.5-1
	6-72	15-32	1.40-1.70	6.0-20	0.02-0.16	5.6-6.5	Low----------	0.28		
24:										
Clebit----------	0-6	10-20	1.30-1.60	2.0-6.0	0.05-0.10	4.5-5.5	Low----------	0.28	1	.5-1
	6-12	10-20	1.30-1.60	2.0-6.0	0.04-0.10	4.5-5.5	Low----------	0.28		
	12-24	---	---	---	---	---	-------------	----		
Pirum----------	0-4	18-27	1.30-1.60	0.6-2.0	0.08-0.12	4.5-5.5	Low----------	0.20	2	.5-2
	4-40	18-35	1.25-1.60	0.6-2.0	0.12-0.16	4.5-5.5	Low----------	0.32		
	40-50	---	---	---	---	---	-------------	----		
Rock outcrop.										
25--------------- Leadvale	0-6	12-22	1.30-1.40	0.6-2.0	0.17-0.22	4.5-5.5	Low----------	0.43	3	1-4
	6-29	20-32	1.30-1.50	0.6-2.0	0.17-0.20	4.5-5.5	Low----------	0.43		
	29-48	20-35	1.55-1.70	0.06-0.6	0.06-0.11	4.5-5.5	Low----------	0.43		
	48-60	30-45	1.40-1.60	0.06-0.6	0.06-0.11	4.5-5.5	Low----------	0.24		
26--------------- Magnet	0-6	15-25	1.40-1.60	2.0-6.0	0.14-0.17	5.1-6.5	Low----------	0.37	3	2-4
	6-30	30-55	1.25-1.45	0.2-0.6	0.13-0.18	5.1-6.5	High---------	0.28		
	30-72	---	---	---	---	---	-------------	----		
27--------------- Mazarn	0-4	10-25	1.30-1.50	0.6-2.0	0.18-0.22	4.5-5.5	Low----------	0.37	2	2-4
	4-14	18-35	1.30-1.60	0.2-2.0	0.16-0.20	4.5-5.5	Low----------	0.37		
	14-30	18-35	1.30-1.60	0.2-2.0	0.16-0.20	4.5-5.5	Low----------	0.32		
	30-36	18-40	1.30-1.60	0.2-0.6	0.12-0.18	4.5-5.5	Low----------	0.32		
	36-40	---	---	---	---	---	-------------	----		
28, 29, 30:										
Pirum----------	0-4	18-27	1.30-1.60	0.6-2.0	0.08-0.12	4.5-5.5	Low----------	0.20	2	.5-2
	4-40	18-35	1.25-1.60	0.6-2.0	0.12-0.16	4.5-5.5	Low----------	0.32		
	40-50	---	---	---	---	---	-------------	----		
Clebit----------	0-6	10-20	1.30-1.60	2.0-6.0	0.05-0.10	4.5-5.5	Low----------	0.28	1	.5-1
	6-12	10-20	1.30-1.60	2.0-6.0	0.04-0.10	4.5-5.5	Low----------	0.28		
	12-24	---	---	---	---	---	-------------	----		
Carnasaw--------	0-5	15-26	1.30-1.60	0.6-2.0	0.10-0.20	4.5-5.5	Low----------	0.24	4	.5-2
	5-11	35-45	1.45-1.70	0.2-0.6	0.12-0.20	4.5-5.5	High---------	0.37		
	11-32	40-60	1.35-1.60	0.06-0.2	0.12-0.18	4.5-5.5	High---------	0.32		
	32-42	40-60	1.35-1.60	0.06-0.2	0.07-0.15	4.5-5.5	High---------	0.32		
	42-50	---	---	---	---	---	-------------	----		

TABLE 14.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH				Pct
31:										
Pits.										
Udorthents.										
32, 33, 34:										
Sherless	0-11	5-18	1.30-1.60	2.0-6.0	0.08-0.13	4.5-5.5	Low	0.20	3	<1
	11-39	20-35	1.45-1.70	0.6-2.0	0.09-0.18	4.5-5.5	Low	0.28		.5-1
	39-42	---	---	---	---	---	---	---		
Clebit	0-6	10-20	1.30-1.60	2.0-6.0	0.04-0.08	4.5-5.5	Low	0.17	1	.5-1
	6-12	10-20	1.30-1.60	2.0-6.0	0.04-0.10	4.5-5.5	Low	0.28		
	12-24	---	---	---	---	---	---	---		
35 Spadra	0-3	10-26	1.30-1.60	0.6-2.0	0.11-0.24	4.5-5.5	Low	0.37	5	1-3
	3-60	18-32	1.30-1.60	0.6-2.0	0.12-0.20	4.5-5.5	Low	0.37		
	60-72	15-25	1.30-1.60	0.6-2.0	0.10-0.15	4.5-5.5	Low	0.24		
36:										
Udorthents.										
37 Yanush	0-5	18-26	1.30-1.55	0.6-2.0	0.08-0.17	5.5-6.0	Low	0.32	5	.5-2
	5-72	27-35	1.45-1.70	0.6-2.0	0.05-0.11	4.5-5.5	Low	0.28		
38, 39:										
Yanush	0-5	18-26	1.30-1.55	0.6-2.0	0.08-0.17	5.5-6.0	Low	0.32	5	.5-2
	5-72	27-35	1.45-1.70	0.6-2.0	0.05-0.11	4.5-5.5	Low	0.28		
Avant	0-3	5-20	1.30-1.60	0.6-2.0	0.06-0.16	4.5-6.0	Low	0.24	2	2-4
	3-7	5-20	1.30-1.60	0.6-2.0	0.06-0.16	4.5-6.0	Low	0.24		
	7-17	10-25	1.25-1.55	0.6-2.0	0.06-0.16	4.5-6.0	Low	0.24		
	17-36	15-35	1.20-1.50	0.6-2.0	0.04-0.14	4.5-6.0	Low	0.20		
	36-42	---	---	---	---	---	---	---		

TABLE 15.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
1----------------- Avant	B	None--------	---	---	>6.0	---	---	20-40	Rippable	Moderate	Moderate.
2, 3------------- Avilla	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
4, 5:											
Bigfork----------	C	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	High.
Rock outcrop.											
6, 7:											
Bigfork----------	C	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	High.
Yanush-----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
Carnasaw---------	C	None--------	---	---	>6.0	---	---	40-60	Soft	High-----	High.
8, 9, 10:											
Bismarck---------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	Moderate.
Carnasaw---------	C	None--------	---	---	>6.0	---	---	40-60	Soft	High-----	High.
11:											
Bismarck---------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	Moderate.
Clebit-----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	Low------	Moderate.
12:											
Bismarck---------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	Moderate.
Clebit-----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	Low------	Moderate.
Sherless---------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
13, 14:											
Bismarck---------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	Moderate.
Sherless---------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
Clebit-----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	Low------	Moderate.
15---------------- Bonnerdale	B	Occasional	Very brief to brief.	Dec-Apr	0.5-1.0	Perched	Dec-May	>40	Soft	Moderate	High.
16, 17----------- Carnasaw	C	None--------	---	---	>6.0	---	---	40-60	Soft	High-----	High.
18:											
Carnasaw---------	C	None--------	---	---	>6.0	---	---	40-60	Soft	Hih-----	High.
Clebit-----------	D	None--------	---	---	>6.0	---	---	10-20	Hard	Low------	Moderate.
19, 20:											
Carnasaw---------	C	None--------	---	---	>6.0	---	---	40-60	Soft	High-----	High.
Pirum------------	B	None--------	---	---	>6.0	---	---	22-50	Hard	Low------	High.

TABLE 15.--SOIL AND WATER FEATURES--Continued

Map symbol and soil name	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness	Uncoated steel	Concrete
					Ft			In			
21, 22:											
Carnasaw----------	C	None---------	---	---	>6.0	---	---	40-60	Soft	High------	High.
Pirum-------------	B	None---------	---	---	>6.0	---	---	22-50	Hard	Low-------	High.
Clebit------------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Low-------	Moderate.
23----------------- Ceda	B	Frequent-----	Very brief	Dec-Jun	>6.0	---	---	>60	---	Low-------	Moderate.
24:											
Clebit------------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Low-------	Moderate.
Pirum-------------	B	None---------	---	---	>6.0	---	---	22-50	Hard	Low-------	High.
Rock outcrop.											
25----------------- Leadvale	C	None---------	---	---	2.0-3.0	Perched	Jan-Apr	>48	Soft	Moderate	Moderate.
26----------------- Magnet	C	None---------	---	---	>6.0	---	---	20-50	Soft	Moderate	Low.
27----------------- Mazarn	C	Occasional	Very brief to brief.	Dec-May	1.0-2.0	Perched	Dec-May	20-40	Soft	High------	High.
28, 29, 30:											
Pirum-------------	B	None---------	---	---	>6.0	---	---	22-50	Hard	Low-------	High.
Clebit------------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Low-------	Moderate.
Carnasaw----------	C	None---------	---	---	>6.0	---	---	40-60	Soft	High------	High.
31:											
Pits.											
Udorthents.											
32, 33, 34:											
Sherless----------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate.
Clebit------------	D	None---------	---	---	>6.0	---	---	10-20	Hard	Low-------	Moderate.
35----------------- Spadra	B	Occasional	Very brief to brief.	Dec-Apr	>6.0	---	---	>60	---	Low-------	High.
36:											
Udorthents.											
37----------------- Yanush	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
38, 39:											
Yanush------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate.
Avant-------------	B	None---------	---	---	>6.0	---	---	20-40	Rippable	Moderate	Moderate.

TABLE 16.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Avant	Loamy-skeletal, siliceous, thermic Typic Hapludults
Avilla	Fine-loamy, siliceous, thermic Typic Paleudults
Bigfork	Loamy-skeletal, siliceous, thermic Typic Hapludults
Bismarck	Loamy-skeletal, mixed, thermic, shallow Typic Dystrochrepts
*Bonnerdale	Coarse-loamy, siliceous, thermic Aquic Hapludults
Carnasaw	Clayey, mixed, thermic Typic Hapludults
Ceda	Loamy-skeletal, siliceous, nonacid, thermic Typic Udifluvents
Clebit	Loamy-skeletal, siliceous, thermic Lithic Dystrochrepts
Leadvale	Fine-silty, siliceous, thermic Typic Fragiudults
Magnet	Fine, mixed, thermic Ultic Hapludalfs
Mazarn	Fine-loamy, siliceous, thermic Aquic Hapludults
Pirum	Fine-loamy, siliceous, thermic Typic Hapludults
Sherless	Fine-loamy, mixed, thermic Typic Hapludults
Spadra	Fine-loamy, siliceous, thermic Typic Hapludults
Yanush	Loamy-skeletal, siliceous, thermic Typic Paleudalfs

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

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